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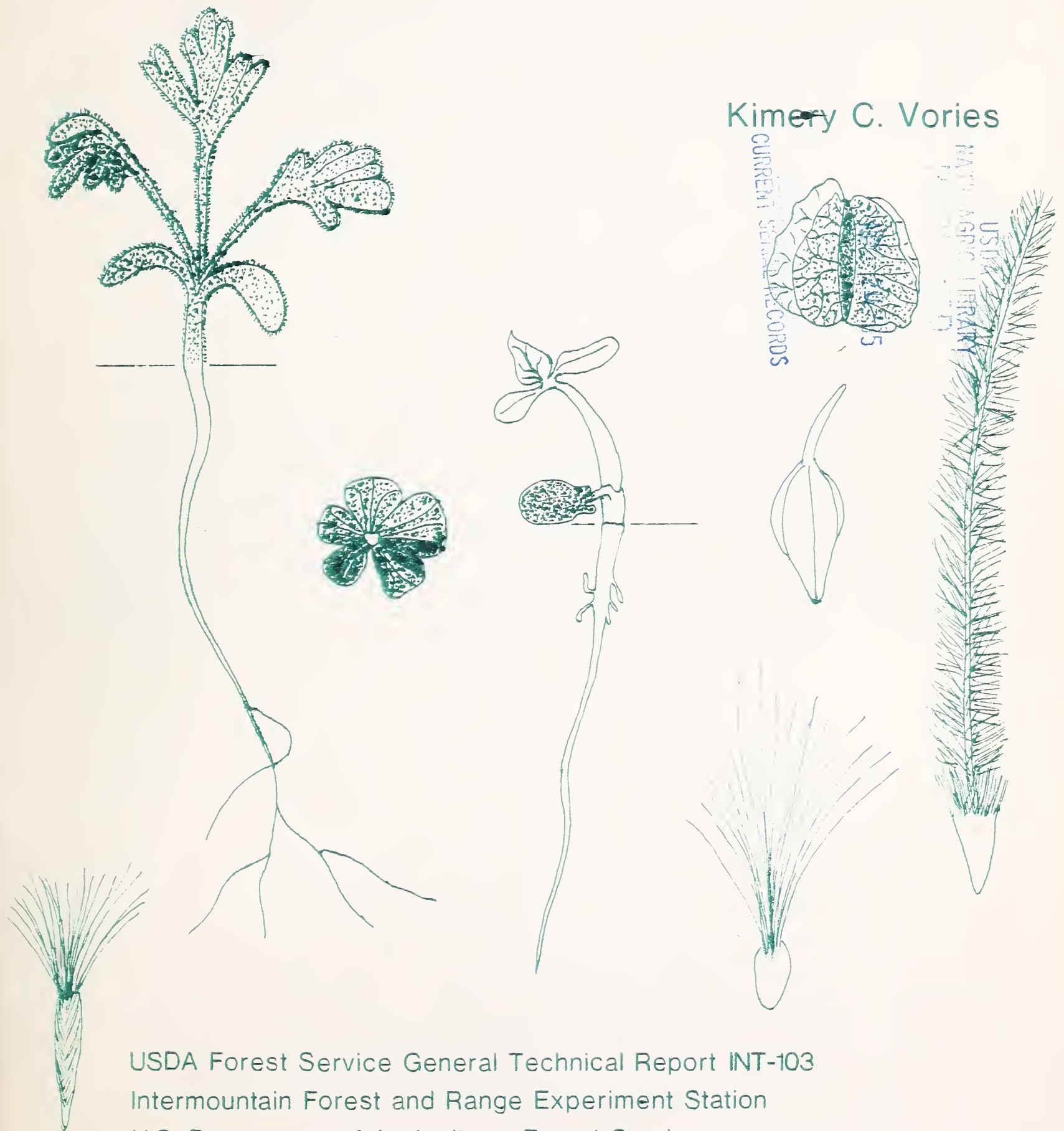
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# GROWING COLORADO PLANTS FROM SEED: A State of the Art

## VOLUME I: SHRUBS

Kimery C. Vories



USDA Forest Service General Technical Report INT-103  
Intermountain Forest and Range Experiment Station  
U.S. Department of Agriculture, Forest Service

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U.S. Department of Agriculture  
Forest Service  
Ogden, Utah 84401

## THE AUTHOR

KIMERY C. VORIES, environmental engineer, is in charge of the environmental program for the Prairie Hill mine and the Bee Veer mine for the Associated Electric Cooperative in north-central Missouri. He is responsible for development of all baseline investigations, permitting, and land reclamation programs. He received his B.A. degree and M.A. degree in biology and geology from Western State College, Gunnison, Colo. He has done additional graduate work in plant ecology, soils, and range science at the University of Massachusetts, Amherst, Mass., and at Colorado State University, Fort Collins, Colo.

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# RESEARCH SUMMARY

Information on the germination and establishment of wildland shrubs has increased with interest in reestablishing self-supporting ecosystems on lands disturbed by human activity. Available information is of variable quality, quantity, and accessibility. The purpose of this investigation was to compile existing germination and plant propagation information for persons planting native or naturalized Colorado shrubs. Included is information on the seed procurement, pretreatment, laboratory germination, and culture of 127 Colorado shrub species. Also included are 234 literature citations, a list of the Colorado shrub species that have been evaluated by USDA Soil Conservation Plant Materials Centers, addresses of plant materials centers in the western United States, a list of the commercial suppliers of Colorado shrub seed, seedlings, and transplants, and a list of the addresses of commercial suppliers of Colorado shrubs.

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# INTRODUCTION

Many western reclamation sites are characterized by the absence of vegetative cover, limited moisture, inadequate organic matter, harsh climate, and infertile soils. The expense of improving these conditions by topsoiling, grading, cultivation, irrigation, fertilization, and intensive management is prohibitively expensive in terms of the land's potential agricultural value. One alternative is to establish vigorous self-sustaining ecosystems similar to native ecosystems. This alternative, however, requires the reclamation specialist to establish a wide variety of native and domesticated plants in a wide variety of western environments.

With the recent development of such computerized information storage and retrieval systems as the Plant Information Network (Vories and Sims 1977), we have a sophisticated tool for determining plant adaptability and the desirability of planting on a given site. It soon becomes apparent, however, that even with the knowledge that a plant would be desirable or adaptable on a given site, our knowledge of how to propagate and cultivate nondomesticated plants under field conditions generally is inadequate. Information is scattered through the literature and difficult to collect and compile. The Forest Service publication "Seeds of Woody Plants in the United States" (Schopmeyer 1974) has greatly enhanced the accessibility of information pertaining to shrubs and trees. Many Colorado species were not covered because of that publication's national coverage.

The objectives here are to:

1. Make all published information on the germination and culture of Colorado shrubs available in an easily used and understood publication.
2. Identify the Colorado shrubs that have been researched extensively and those that are relatively unknown in terms of germination characteristics and planting technology.
3. Identify publications that would be useful for persons interested in landscaping or field establishment of Colorado shrubs.

## METHODS

The investigation consisted of three phases. Phase 1 was the actual literature search, an exhaustive search of bibliographies, publications, periodicals, and government agency reports. The information was recorded on special forms and each article abstracted or summarized. Phase 2 was an evaluation of reports on the results of tests with Colorado shrubs by USDA Soil Conservation Service Plant Materials Centers. A card file was set up indexing the species being evaluated. Phase 3 was an evaluation of information provided by commercial suppliers concerning the types and names of plant materials they handled. This phase consisted of recording whether a species was supplied as seed, bare root seedlings, or potted transplants, and which suppliers handled it.

The information is presented by species in four general categories: procurement, pretreatment, laboratory germination, and cultural practices. Because of wide variability in the quality of information available, the source of each bit of information is cited. The order of citation is from the newest to the oldest, the supposition being that, in the majority of cases, the most recent citations should be those of the highest quality. Some earlier publications, however, can only be described as classics.

## SUMMARY OF RESULTS

According to information provided by the Plant Information Network, Department of Botany and Plant Pathology, Colorado State University, there are between 204 and 248 native or naturalized Colorado shrub species. (The difference of 44 species being those plants which may have characteristics of both shrubs and trees.) The author located information in 234 different publications on the 127 species listed in this publication.

Nine of the shrubs had excellent seed propagation information, with substantial amounts of information in each of the four main information categories. They were: *Amelanchier alnifolia*, *Arctostaphylos uva-ursi*, *Artemisia tridentata tridentata*, *Atriplex canescens*, *A. confertifolia*, *A. gardneri* (formally called *A. nuttallii*), *Ceratoides lanata*, *Cercocarpus montanus*, and *Purshia tridentata*. Twenty-three shrubs had an adequate amount of seed propagation information in all four categories, although the information was not as extensive as for the nine above. They were: *Acer glabrum*, *Amelanchier utahensis*, *Artemisia arbuscula*, *A. cana*, *A. nova*, *Ceanothus velutinus*, *Cercocarpus ledifolius*, *Cornus stolonifera*, *Cowania mexicana stansburiana*, *Elaeagnus angustifolia*, *Grayia spinosa*, *Mahonia repens*, *Prunus americana*, *P. virginiana*, *Rhus glabra*, *R. trilobata*, *Rosa nutkana*, *Salix bebbiana*, *S. exigua*, *S. scouleriana*, *Sambucus coerulea*, *Shepherdia argentea*, and *Tamarix pentandra*. Twenty shrubs had marginal seed propagation and laboratory germination information in addition to having incomplete cultural information. They were: *Amorpha canescens*, *A. fruticosa*, *A. nana*, *Arctostaphylos patula*, *Atriplex obovata*, *Chrysothamnus nauseosus*, *C. viscidiflorus*, *Clematis ligusticifolia*, *Ephedra viridis*, *Fallugia paradoxa*, *Juniperus communis*, *Peraphyllum ramosissimum*, *Ribes cereum*, *Rubus occidentalis*, *Sambucus canadensis*, *S. racemosa*, *Shepherdia canadensis*, *Symphoricarpos albus albus*, *S. orbiculatus*, and *Yucca glauca*. There are major gaps in the seed propagation information for the remaining 75 species listed.

A poll of USDA Soil Conservation Service Plant Materials Centers revealed that 107 native or naturalized Colorado shrubs were presently being evaluated. Although these centers rarely have seed available for other uses, they should be a good source of information on the propagation of plants that have not been evaluated in the literature.

Seventy-one native or naturalized Colorado shrub species were found to be at least potentially available from 28 different commercial suppliers. The annual seed crop, time of year, and numerous other variables determine whether or not these species will be available. Under favorable conditions, these species can be obtained as seed, bare root seedlings, or containerized stock.

Additional sources of propagation information related to Colorado shrub species can be obtained through the Intermountain Station's Shrub Sciences Laboratory in Provo, Utah, or through the Rocky Mountain Forest and Range Experiment Station.

## GERMINATION AND PROPAGATION INFORMATION BY SPECIES





*ACER GLABRUM* Torr.  
(Rocky Mountain Maple)

FAMILY: Aceraceae  
LIFEFORM: Native tree 2-6 m tall (Harrington, 1964)  
FRUIT: Samara 2-3 cm long (Harrington, 1964)

PROCUREMENT

SEEDS/LB: 7,820-20,300--avg 13,430 (Olson & Gabriel, 1974); 13,200-20,300 (Swingle, 1939)  
SEED MATURITY: Aug-Sep, 1-3 years between seed crop (Olson & Gabriel, 1974); Summer (Swingle, 1939)  
METHOD OF COLLECTION: Hand pick or shake trees onto canvas (Olson & Gabriel, 1974)

PRETREATMENT

METHOD OF STORAGE: Dry in sealed containers at 35-41°F (Olson & Gabriel, 1974); Cellar (Swingle, 1939)  
DURATION OF GOOD VIABILITY: 1-2 years (Olson & Gabriel, 1974)  
STRATIFICATION AND SCARIFICATION: Warm stratify at 68-86°F for 180 days then moist chill at 37-41°F for 180 days (Olson & Gabriel, 1974); Moist chill at 3-5°C for 2-6 months (Heit, 1968); Moist chill at 41°C for 90 days (Babb, 1959); Needs a long stratification period (Peterson, 1953); Moist chill December thru March (Swingle, 1939)

LABORATORY GERMINATION

TEMPERATURE: Best at a constant 50-60°F (Olson & Gabriel, 1974)  
MOISTURE: Moist (Olson & Gabriel, 1974)  
GERMINATION ENERGY: 40% in 30 days (Olson & Gabriel, 1974)  
GERMINATION CAPACITY: 52% (Swingle, 1939)  
COMMENTS: Difficult to overcome dormancy (Heit, 1968)

CULTURAL PRACTICES

PLANTING DEPTH: 1/4-1" deep (Olson & Gabriel, 1974)  
PLANTING TIME: Best in fall but okay in spring with stratified seed (Olson & Gabriel, 1974; Babb, 1959); Fall or spring (Swingle, 1939)  
EXPOSURE: Shade during establishment (Olson & Gabriel, 1974)

*AMELANCHIER ALNIFOLIA* (Nutt.) Nutt.  
(Saskatoon Serviceberry)

FAMILY: Rosaceae  
LIFEFORM: Native shrub 1-4 m tall (Harrington, 1964)  
FRUIT: Berry-like pome 5-9 mm in diameter (Blauer et al., 1975)  
SEED: Small with leathery seed coat (Brinkman, 1974a)

PROCUREMENT

SEEDS/LB: 36,000-113,800--avg 82,000 (Brinkman, 1974a); 45,395 (Plummer et al., 1968); 51,300-112,650 (Swingle, 1939); 36,300 (McKeever, 1938)  
SEED MATURITY: Seed crop every 3-5 years UT (Blauer et al., 1975); Jul-Aug (Brinkman, 1974a); Jul 10-Sep 15 UT (Plummer et al., 1968); Early summer (Swingle, 1939)  
METHOD OF COLLECTION: Knock onto a canvas or into hoppers (Plummer et al., 1968)  
METHOD OF CLEANING: Dybvig with water, dry and fan (Plummer et al., 1968)

PRETREATMENT

METHOD OF STORAGE: Dry storage in sealed containers at 41°F (Brinkman, 1974a; Swingle, 1939)  
DURATION OF GOOD VIABILITY: 5 years (Plummer et al., 1968); Less than 5 years (King, 1947)  
STRATIFICATION AND SCARIFICATION: Moist chill at 33-43°F for 4-6 months (Brinkman, 1974a; Heit, 1968); Moist chill at 1°C for 120 days, acid treatment not necessary (McLean, 1967); 60 minute soak in sulfuric acid aided germination (Waitman, 1961); Moist chill at 41°F for 120 days (Babb, 1959); Moist chill at 5°C for 98-112 days, 30, 60, and 90 minute soaks in sulfuric acid did not aid germination (Hervey, 1955); Moist chill at 40°F for 140 days (Swingle, 1939); Moist chill at 5°C in sand for 140 days (McKeever, 1938)

LABORATORY GERMINATION

TEMPERATURE: Either 70°F constant or alternating 86°F day and 68°F night (Brinkman, 1974a); Germinates well as low as 1.5°C (Hargrove, 1937)  
MOISTURE: Moist (White, 1968)  
LIGHT: Light not necessary (Brinkman, 1974a)  
GERMINATIVE ENERGY: 76% in 150 days (Monsen & Christensen, 1975); 50% in 8 days (Brinkman, 1974a)  
GERMINATIVE CAPACITY: 85% in 180 days (Monsen & Christensen, 1975); 62-70% in 30-70 days (Brinkman, 1974a); 98% (McLean, 1967); 3% (Hervey & Boyd, 1953); 99% in 6 days (McKeever, 1938)  
COMMENTS: Large percentage of infertile and insect infested seeds (White, 1968); Should remove fruit from seed before germination (Hervey & Boyd, 1953); Dormancy is due to dormant or immature embryo (McKeever, 1938)

CULTURAL PRACTICES

PLANTING DEPTH: 1/4" (Brinkman, 1974a)  
PLANTING TIME: Fall or with stratified seed in spring (Monsen & Christensen, 1975; Brinkman, 1974a); Spring (Swingle, 1939)  
EXPOSURE: 1/2 shade during first year (Brinkman, 1974a); Shade during establishment (White, 1968; Hervey, 1955)

SOIL TEXTURE: Sandy (Brinkman, 1974a); Medium (Sutton & Johnson, 1974); Not on clayey soils (White, 1968)  
 SOIL pH: 6.0-7.0 (Sutton & Johnson, 1974); 5.3-7.8 (White, 1968)  
 SOIL DEPTH: Deep (Sutton & Johnson, 1974)  
 ORGANIC MATTER: If possible (Sutton & Johnson, 1974)  
 DRAINAGE: Well drained (Sutton & Johnson, 1974)  
 NURSERY PLANTING: Plant soon after collection, drill at 25 seed/linear foot, mulch (Brinkman, 1974a)  
 GREENHOUSE PLANTING: Can be propagated vegetatively with soft wood and root cuttings (Harris, 1961)  
 FIELD PLANTING: Under normal conditions germination begins in spring under snow or shortly after snowmelt (McKeever, 1938)

*AMELANCHIER UTAHENSIS* Koehne  
 (Utah Serviceberry)

FAMILY: Rosaceae  
 LIFEFORM: Native shrub 1-4 m tall (Harrington, 1964)  
 FRUIT: Berry-like pome, 6-10 mm in diameter (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 25,800 (Plummer et al., 1968); 31,500 (Swingle, 1939)  
 SEED MATURITY: Aug 25-Apr 1 UT (Plummer et al., 1968)  
 METHOD OF COLLECTION: Knock onto canvas or into hopper (Plummer et al., 1968)  
 METHOD OF CLEANING: Dybvig with water, dry, fan (Plummer et al., 1968)

#### PRETREATMENT

DURATION OF GOOD VIABILITY: 5 years (Plummer et al., 1968)  
 STRATIFICATION AND SCARIFICATION: Moist chill at 3-5°C for 1.5 months (Heit, 1970) or 2-6 months (Heit, 1968)

#### LABORATORY GERMINATION

TEMPERATURE: 6°C constant (Monsen & Christensen, 1975); 30°C day and 10°C night alternating (Heit, 1970)  
 MOISTURE: Moist (White, 1968)  
 GERMINATION ENERGY: 40% in 60 days (Monsen & Christensen, 1975)  
 GERMINATIVE CAPACITY: 95% in 150 days (Monsen & Christensen, 1975); 90% in 15 days (Heit, 1970)  
 COMMENTS: Large percentage of infertile and insect infested seed (White, 1968)

#### CULTURAL PRACTICES

PLANTING TIME: Fall (Monsen & Christensen, 1975)  
 EXPOSURE: Shade during establishment (White, 1968); Sun when mature (Stark, 1966)

SOIL TEXTURE: Not on clayey soils (White, 1968); Medium to coarse (Stark, 1966)  
 SOIL pH: 5.3-7.8 (White, 1968)  
 SOIL DEPTH: Moderate to deep (Stark, 1966)  
 SOIL MOISTURE: Dry, 8-14" precipitation zone (Stark, 1966)  
 DRAINAGE: Well-drained (Stark, 1966)

*AMORPHA CANESCENS* Pursh.  
 (Leadplant Amorpha)

FAMILY: Fabaceae  
 LIFEFORM: Native shrub 30-100 cm tall (Harrington, 1964)  
 FRUIT: Small, 2-seeded legume (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 296,000 (Brinkman, 1974b); 87,900-105,754 (Swingle, 1939)  
 SEED MATURITY: Aug-Sep (Brinkman, 1974b); Late summer (Swingle, 1939)  
 METHOD OF COLLECTION: Strip from branches (Brinkman, 1974b)

#### PRETREATMENT

METHOD OF STORAGE: Dry in sealed containers at 41°F (Brinkman, 1974b; Swingle, 1939)  
 STRATIFICATION AND SCARIFICATION: Sow in fall or soak in hot water for 10 minutes (Brinkman, 1974b); Soak in hot water at 180-200°F for 12 hours then moist chill at 41°F for 30 days (Babb, 1959)

#### LABORATORY GERMINATION

TEMPERATURE: 86°F day and 68°F night alternating (Brinkman, 1974b)  
 GERMINATIVE ENERGY: 79% in 14 days (Brinkman, 1974b)  
 GERMINATIVE CAPACITY: 28% in 15-40 days (Brinkman, 1974b)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4-3/16" (Brinkman, 1974b)  
 PLANTING TIME: Fall (Brinkman, 1974b; Swingle, 1939)  
 GREENHOUSE PLANTING: Reproduces well by cuttings (Swingle, 1939)  
 FIELD PLANTING: Sow in pods (Brinkman, 1974b)

*AMORPHA FRUITICOSA* L.  
 (Indigobush Amorpha)

FAMILY: Fabaceae  
 LIFEFORM: Native shrub 2-4 m tall (Harrington, 1964)  
 FRUIT: A legume 7-8 mm long (Harrington, 1964)



#### PROCUREMENT

SEEDS/LB: 72,000-82,000--avg 77,000 (Brinkman, 1974b); 54,613-67,200 (Swingle, 1939)  
SEED MATURITY: Aug (Brinkman, 1974b); Late summer or fall (Swingle, 1939)  
METHOD OF COLLECTION: Strip from branches (Brinkman, 1974b)

#### PRETREATMENT

METHOD OF STORAGE: Dry in sealed containers at 41°F (Brinkman, 1974b; Swingle, 1939)  
DURATION OF GOOD VIABILITY: 3-5 years (Brinkman, 1974b)  
STRATIFICATION AND SCARIFICATION: Sow in fall or soak in hot water for 10 minutes, or soak in sulfuric acid for 5-8 minutes (Brinkman, 1974b); Soak in sulfuric acid for 5-8 minutes then moist chill at 41°F for 30 days (Babb, 1959); Stratification not necessary (Swingle, 1939)

#### LABORATORY GERMINATION

TEMPERATURE: 86°F day and 68°F night alternating (Brinkman, 1974b)  
GERMINATIVE CAPACITY: 63% in 15-20 days (Brinkman, 1974b); 42-75% (Swingle, 1939)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4-3/16" (Brinkman, 1974b)  
PLANTING TIME: Fall or spring (Swingle, 1939)  
GREENHOUSE PLANTING: Reproduces well by cuttings (Swingle, 1939)  
FIELD PLANTING: Sow in pods (Brinkman, 1974b)

*AMORPHA NANA* Nutt.  
(Dwarfindigo Amorphia)

FAMILY: Fabaceae  
LIFEFORM: Native shrub 30-90 cm tall (Harrington, 1964)  
FRUIT: One-seeded pod 5 mm long (Rogers, 1931)

#### PROCUREMENT

SEEDS/LB: 59,682 (Swingle, 1939)  
SEED MATURITY: July (Brinkman, 1974b)  
METHOD OF COLLECTION: Strip from branches (Brinkman, 1974b)

#### PRETREATMENT

METHOD OF STORAGE: Dry in sealed containers at 41°F (Brinkman, 1974b)  
STRATIFICATION AND SCARIFICATION: Sow in fall, or soak in hot water for 10 minutes, or soak in sulfuric acid for 5-10 minutes (Brinkman, 1974b); Soak in sulfuric acid for 7-8 minutes (Rogers, 1931)

#### LABORATORY GERMINATION

TEMPERATURE: 86°F day and 68°F night alternating (Brinkman, 1974b); 21°C (Rogers, 1931)

GERMINATIVE ENERGY: 40% in 10 days (Rogers, 1931)

GERMINATIVE CAPACITY: 70% in 30-40 days (Brinkman, 1974b); 50% (Swingle, 1939); 70% in 60 days (Rogers, 1931)

COMMENTS: Germination not affected by sub-freezing temperatures or by temperatures of moderately dry heat (68-74°C); the outer part of the outer layer of the seed coat is impermeable to water; scarification with sulfuric acid hastens germination but does not increase the total (Rogers, 1931)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4-3/16" (Brinkman, 1974b)  
GREENHOUSE PLANTING: Reproduces well from cuttings (Swingle, 1939)  
FIELD PLANTING: Sow in pods (Brinkman, 1974b)

*ARCTOSTAPHYLOS PATULA* Greene  
(Greenleaf Manzanita)

FAMILY: Ericaceae  
LIFEFORM: Native evergreen shrub 1-2 m tall (Harrington, 1964)  
FRUIT: Berry-like, 8-10 mm wide with 4-10 seedlike nutlets (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 18,000 (Berg, 1974); 1,700 dry fruits (Swingle, 1939)  
SEED MATURITY: Jul-Sep (Berg, 1974); May-Sep NV (Stark, 1966); Aug-Oct (Swingle, 1939)  
METHOD OF COLLECTION: Collect by hand or pick off ground, best to collect in late fruit-development (Berg, 1974)  
METHOD OF CLEANING: Macerate fruit and separate nutlets by floatation or blowing (Berg, 1974)

#### PRETREATMENT

STRATIFICATION AND SCARIFICATION: Soak in sulfuric acid for 4 hours then moist chill for 120 days (Berg, 1974); Soak in sulfuric acid for 3-6+ hours then moist chill at 40°F for 90 days in moist sand (Stark, 1966); Moist chill at 40°F for 90 days (Swingle, 1939)

#### LABORATORY GERMINATION

TEMPERATURE: 86°F day and 68°F night alternating (Berg, 1974)  
GERMINATIVE CAPACITY: 20% in 60 days (Berg, 1974)  
COMMENTS: Caution needed in scarification process to avoid damaging embryo (Berg, 1974)

#### CULTURAL PRACTICES

PLANTING TIME: Early summer (Berg, 1974); Spring or fall (Stark, 1966)



EXPOSURE: Sun (Sutton & Johnson, 1974; Stark, 1966)  
 SOIL TEXTURE: Coarse (Sutton & Johnson, 1974)  
 SOIL pH: 5.0-6.0 (Sutton & Johnson, 1974)  
 SOIL DEPTH: Moderate, 12-37" (Sutton & Johnson, 1974)  
 PRECIPITATION: Less than 20" (50 cm) annually (Sutton & Johnson, 1974); 20" (Stark, 1966)  
 ORGANIC MATTER: No (Sutton & Johnson, 1974)  
 DRAINAGE: Well-drained (Sutton & Johnson, 1974)  
 GREENHOUSE PLANTING: 2-3" branch tips can be propagated in a frame with bottom heat (Mirov & Kraebel, 1939)  
 NURSERY PLANTING: Mulch seedbeds (Berg, 1974); Manzanitas are easier to propagate from cuttings than seeds (Mirov & Kraebel, 1937)

*ARCTOSTAPHYLOS UVA-URSI* (L.) Spreng.  
 (Bearberry)

FAMILY: Ericaceae  
 LIFEFORM: Native evergreen prostrate shrub with branches to 15 cm long (Harrington, 1964)  
 FRUIT: Berry-like, 6-10 mm wide with 4-10 seedlike nutlets (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 26,800-58,000 (Berg, 1974); 37,900 (Glazebrook, 1941); 26,800 (Swingle, 1939); McKeever, 1938)  
 SEED MATURITY: Jun-Aug (Berg, 1974); Jun to fall (Swingle, 1939)  
 METHOD OF COLLECTION: Collected by hand or picked off ground, best to collect in late fruit development (Berg, 1974)  
 METHOD OF CLEANING: Macerate fruit and separate nutlets by floatation or blowing (Berg, 1974)

#### PRETREATMENT

METHOD OF STORAGE: Dry at room temperature (Glazebrook, 1941)  
 STRATIFICATION AND SCARIFICATION: Soak in sulfuric acid 2-5 hours and plant in early summer or warm stratify at 25°C for 60-120 days then moist chill for 60-90 days (Milstein & Milstein, 1976; Berg, 1974); Soak in sulfuric acid for 7 hours then warm stratify at 20°C for 90 days then moist chill at 1°C for 90 days (McLean, 1967); Warm stratify at 77°F for 60 days then moist chill at 41°F for 60 days, or soak entire stones in sulfuric acid for 3-5 hours (Babb, 1959); Soak in sulfuric acid for 6 hours, then warm stratify at room temperature for 60 days, then moist chill at 4°C for 60 days (Glazebrook, 1941); Soak in sulfuric acid for 3-5 hours (Swingle, 1939); Soak in sulfuric acid for 3-5 hours then over-winter outdoors in mulch frame (Giersbach, 1937a)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 75-80°F (Milstein & Milstein, 1976); Either constant at 77°F or alternating 86°F day and 68°F night (Berg, 1974)  
 GERMINATIVE ENERGY: 70% in 13 days (Glazebrook, 1941)  
 GERMINATIVE CAPACITY: 15-30 days (Milstein & Milstein, 1976); 30-61% in 16 days (Berg, 1974); 34% (McLean, 1967); 93% in 25 days (Glazebrook, 1941); 75% (Swingle, 1939); 65-76% (Giersbach, 1937a)  
 COMMENTS: 69% sound seed, dormancy due to hard seed coat and embryo which needs after-ripening (Glazebrook, 1941); Germination unsuccessful (King, 1947).

#### CULTURAL PRACTICES

PLANTING TIME: Early summer for following spring (Milstein & Milstein, 1976); Early summer (Berg, 1974); Immediately after scarification (Swingle, 1939)  
 EXPOSURE: Shade or sun (Sutton & Johnson, 1974)  
 SOIL TEXTURE: Coarse to rocky (Sutton & Johnson, 1974)  
 SOIL pH: 5.0-6.5 (Sutton & Johnson, 1974)  
 SOIL DEPTH: Shallow (Sutton & Johnson, 1974)  
 SOIL MOISTURE: Dry (Sutton & Johnson, 1974)  
 ORGANIC MATTER: Well-drained (Sutton & Johnson, 1974)  
 GREENHOUSE PLANTING: 2-3" branch tips can be propagated in a frame with bottom heat (Mirov & Kraebel, 1937)  
 NURSERY PLANTING: Seeds will germinate in 20-40 days (Milstein & Milstein, 1976); Mulch seedbeds, Manzanitas are easier to propagate from cuttings than seed (Berg, 1974)

*ARTEMISIA ABROTANUM* L.  
 (Oldman Wormwood)

FAMILY: Asteraceae  
 LIFEFORM: Introduced shrub 3-5 ft tall (Plummer, 1974)  
 FRUIT: An achene (Harrington, 1964)

#### PROCUREMENT

SEED MATURITY: Rarely matures seed in the wild (Plummer, 1974)

#### CULTURAL PRACTICES

PLANTING TIME: Spring after snowmelt (Plummer, 1974; Stark, 1966)  
 SOIL pH: Fairly alkaline to fairly acid (Plummer, 1974)  
 PRECIPITATION: 12-40" (Plummer, 1974); 12" (Stark, 1966)  
 FIELD PLANTING: Reproduction by seed rarely seen, readily established in early spring by sticking cuttings 10-18" long and 1/8-1/2" in diameter in soil to a depth of 6" or dependable moisture (Plummer, 1974); Poor establishment from direct seeding (Stark, 1966)

*ARTEMISIA ARBUSCULA* Nutt.  
(Low Sagebrush)

FAMILY: Asteraceae  
LIFEFORM: Native evergreen shrub 10-30 cm  
tall (Harrington, 1964)  
FRUIT: An achene (Harrington, 1964)

PROCUREMENT

SEEDS/LB: 891,000-1,055,000--avg 972,000  
(Deitschman, 1974)  
SEED MATURITY: Nov (Stark, 1966)  
METHOD OF COLLECTION: Shake, beat or hand  
strip seed into shoulder hoppers, baskets,  
or sacks (Deitschman, 1974); Rub or strip  
seed into containers (Plummer et al.,  
1968)  
METHOD OF CLEANING: Hammermill, fan and  
screen (Deitschman, 1974); Hammermill  
(Plummer et al., 1968)

PRETREATMENT

DURATION OF GOOD VIABILITY: 2 years (Plummer  
et al., 1968)  
STRATIFICATION AND SCARIFICATION: Moist chill  
at 36°F for 10 days (Deitschman, 1974)

LABORATORY GERMINATION

TEMPERATURE: Alternating 86°F day and 68°F  
night (Deitschman, 1974)  
LIGHT: Better germination in light (Deitsch-  
man, 1974)  
GERMINATIVE ENERGY: 68-70% in 26-31 days  
(Deitschman, 1974); 24% (Swingle, 1939)

CULTURAL PRACTICES

PLANTING DEPTH: 1/4" (Deitschman, 1974)  
PLANTING TIME: Fall or winter (Deitschman,  
1974); Spring (Stark, 1966)  
EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Clay pan soils, very stony  
(Stark, 1966)  
SOIL DEPTH: Shallow (Stark, 1966)  
PRECIPITATION: 8-14+" (Stark, 1966)  
DRAINAGE: Well-drained (Stark, 1966)  
NURSERY PLANTING: Mulch with light straw  
(Deitschman, 1974)

*ARTEMISIA CANA* Pursh  
(Silver Sagebrush)

FAMILY: Asteraceae  
LIFEFORM: Native evergreen shrub 30-200 cm  
tall (Harrington, 1974)  
FRUIT: An achene, 1/4" in diameter (Sutton &  
Johnson, 1974)

PROCUREMENT

SEEDS/LB: 822,000-870,000 (Eddleman, 1977)  
SEED MATURITY: Late summer-fall UT (Sutton &  
Johnson, 1974)

METHOD OF COLLECTION: Hand pick or use head  
cutter (Eddleman, 1977)  
METHOD OF CLEANING: Mechanical flail (60  
seconds), clipper (1/13)/6x60, seed  
blower (Eddleman, 1977)

PRETREATMENT

METHOD OF STORAGE: Store dry at 20°C (Eddle-  
man, 1977)

LABORATORY GERMINATION

TEMPERATURE: Constant at 10-30°C (Eddleman,  
1977)  
LIGHT: Light is beneficial for germination  
(Eddleman, 1977)  
GERMINATIVE ENERGY: 50% in 2-6 days (Eddle-  
man, 1977)  
GERMINATIVE CAPACITY: 94-97% (Eddleman, 1977)

CULTURAL PRACTICES

PLANTING DEPTH: Surface (Stark, 1966)  
PLANTING TIME: Adequate soil moisture for  
establishment (Eddleman, 1977); Spring  
(Stark, 1966)  
EXPOSURE: Sun (Sutton & Johnson, 1974)  
SOIL TEXTURE: Coarse (Sutton & Johnson, 1974);  
Moderately fine (Stark, 1966)  
SOIL pH: 6.5-8.5 (Sutton & Johnson, 1974);  
Slight saline-alkaline tolerance (Stark,  
1966)  
SOIL DEPTH: Deep (Sutton & Johnson, 1974);  
Over 60" (Stark, 1966)  
SOIL MOISTURE: Dry (Sutton & Johnson, 1974)  
PRECIPITATION: 8-14" (Stark, 1966)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Well-drained (Sutton & Johnson,  
1974)

*ARTEMISIA FILIFOLIA* Torr.  
(Sand Sagebrush)

FAMILY: Asteraceae  
LIFEFORM: Native evergreen shrub 30-150 cm  
tall (Harrington, 1964)  
FRUIT: An achene (Harrington, 1964)

LABORATORY GERMINATION

GERMINATIVE CAPACITY: 56% (Swingle, 1939)

*ARTEMISIA FRIGIDA* Willd.  
(Fringed Sagebrush)

FAMILY: Asteraceae  
LIFEFORM: Native undershrub 10-40 cm tall  
(Harrington, 1964)  
FRUIT: An achene (Harrington, 1964)

PROCUREMENT

SEEDS/LB: 4,536,000 (Plummer et al., 1968)  
SEED MATURITY: Sep 15-Nov 30 UT (Plummer  
et al., 1968)

METHOD OF COLLECTION: Rub or strip into containers (Plummer et al., 1968)  
METHOD OF CLEANING: Hammermill (Plummer et al., 1968)

#### PRETREATMENT

DURATION OF GOOD VIABILITY: 2 years (Plummer et al., 1968)

#### CULTURAL PRACTICES

PLANTING TIME: Spring (Stark, 1966)  
EXPOSURE: Sun (Sutton & Johnson, 1974)  
SOIL TEXTURE: Fine to coarse (Sutton & Johnson, 1974)  
SOIL pH: 7.0 (Sutton & Johnson, 1974)  
SOIL DEPTH: Shallow to deep (Sutton & Johnson, 1974)  
SOIL MOISTURE: Dry (Sutton & Johnson, 1974)  
DRAINAGE: Well-drained (Sutton & Johnson, 1974)

*ARTEMISIA NOVA* A. Nels.  
(Black Sagebrush)

SYNONYMY: *Artemisia arbuscula nova* (A. Nels.) Cronq.; *Artemisia tridentata nova* (A. Nels.) H. & G.

FAMILY: Asteraceae  
LIFEFORM: Native evergreen shrub 10-30 cm tall (Harrington, 1964)  
FRUIT: An achene (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 825,000-965,000--avg 907,000 (Deitschman, 1974); 907,200 (Plummer et al., 1968)  
SEED MATURITY: Oct 15-Nov 30 UT (Plummer et al., 1968)  
METHOD OF COLLECTION: Shake, beat, or hand strip seeds into shoulder hopper, basket, or sack (Deitschman, 1974); Rub or strip into containers (Plummer et al., 1968)  
METHOD OF CLEANING: Hammermill, fan and screen (Deitschman, 1974); Hammermill (Plummer et al., 1968)

#### PRETREATMENT

DURATION OF GOOD VIABILITY: 2 years (Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Moist chill at 36°F for 10 days (Deitschman, 1974)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 38°F (Deitschman, 1974)  
LIGHT: Better germination in light (Deitschman, 1974)  
GERMINATIVE ENERGY: 90% in 60 days (Deitschman, 1974)  
GERMINATIVE CAPACITY: 85% in 100 days (Deitschman, 1974)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4" (Deitschman, 1974)  
PLANTING TIME: Fall or winter (Deitschman, 1974); Spring (Stark, 1966)  
EXPOSURE: Sun (Sutton & Johnson, 1974)  
SOIL TEXTURE: Coarse to rocky (Sutton & Johnson, 1974)  
SOIL pH: 6.5-7.5 (Sutton & Johnson, 1974)  
SOIL DEPTH: Deep (Sutton & Johnson, 1974); 10-16" (Stark, 1966)  
SOIL MOISTURE: Dry (Sutton & Johnson, 1974)  
PRECIPITATION: 8-14" (Stark, 1966)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Well-drained (Sutton & Johnson, 1974)  
NURSERY PLANTING: Mulch with light straw (Deitschman, 1974)

*ARTEMISIA SPINESCENS* D. C. Eaton  
(Bud Sagebrush)

FAMILY: Asteraceae  
LIFEFORM: Native evergreen shrub 5-50 cm tall (Harrington, 1964)  
FRUIT: A hairy achene (Stark, 1966) 1 mm long (Wood, 1966)

#### CULTURAL PRACTICES

EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Fine to medium (Stark, 1966)  
SOIL pH: Alkali and saline tolerant (Stark, 1966); 7.8-9.7 (Wood, 1966)  
SOIL DEPTH: Deep (Stark, 1966; Wood, 1966)  
SOIL MOISTURE: Dry (Stark, 1966)  
PRECIPITATION: 6-10" (Stark, 1966)  
FIELD PLANTING: Flowerheads fall entire, seeds germinate within the head in nature, soil must be wet for at least 30 days or seedlings will not survive (Wood, 1966)

*ARTEMISIA TRIDENTATA TRIDENTATA* Nutt.  
(Big Sagebrush)

FAMILY: Asteraceae  
LIFEFORM: Native evergreen shrub 40-400 cm tall (Harrington, 1964)  
FRUIT: An achene, seeds are 0.69 x 1.43 mm in size and weigh approx 0.0002 g (Goodwin, 1956)

#### PROCUREMENT

SEEDS/LB: 2,383,000-3,238,000--avg 2,466,000 (Deitschman, 1974); 2,575,940 (Plummer et al., 1968)  
SEED MATURITY: Nov 5-Jan 15 UT (Plummer et al., 1968); Oct 15-Dec 30 WA (Goodwin, 1956); Oct-Nov UT (Shepherd, 1937); Seed maturity has a large effect on germination characteristics, early maturing seeds germinate best (Goodwin, 1956)



METHOD OF COLLECTION: Shake, beat, or hand strip into shoulder hopper, baskets, or sack (Deitschman, 1974); Rub or strip into containers (Plummer et al., 1968)  
METHOD OF CLEANING: Hammermill, fan and screen (Deitschman, 1974); Hammermill (Plummer et al., 1968)

#### PRETREATMENT

DURATION OF GOOD VIABILITY: 2 years (Deitschman, 1974; Hull, 1973; Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Moist chill at 36°F for 10 days (Deitschman, 1974; Stark, 1966); Moist chill at 1-3°C for 30-50 days (McDonough & Harniss, 1974a); Germinates well without stratification, germination increases and becomes more rapid with up to 60 day's moist chill at 3-5°C but decreases after 90 days moist chill, scarification in sulfuric acid for 1-2 minutes is detrimental (Goodwin, 1956); Stratification not necessary, germination improved by soaking seed in dilute (N/1000) hydrochloric acid (Shepherd, 1937)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 62-64°F (Deitschman, 1974); 20°C constant or alternating 20°C day and 2°C night (McDonough & Harniss, 1974a); 70°F (Weldon et al., 1959); 17-19°C (Goodwin, 1956)  
MOISTURE: Moist (Weldon et al., 1959); Free water aids germination (Goodwin, 1956); Will germinate with as low as 2.5 atmospheres negative pressure (Choudhuri, 1968)  
LIGHT: Better germination in light (Deitschman, 1974; Weldon et al., 1959; Goodwin, 1956; Shepherd, 1937)  
GERMINATIVE ENERGY: 80% in 40 days (Deitschman, 1974); 27% in 9 days (Shepherd, 1937)  
GERMINATIVE CAPACITY: 56-85% in 100 days (Deitschman, 1974); 56% (McDonough & Harniss, 1974a); 0-94% in 15 days (Payne, 1957); 55-75% (Goodwin, 1956); 32% (Swingle, 1939); 30% (Shepherd, 1937)  
COMMENTS: Germination will occur under a wide range of temperature, moisture, and light conditions (Goodwin, 1956); 25°C temperature inhibits germination (Stark, 1966); Seed may be damaged by high heat but less so when seed is moist, natural germination rates are highly variable due to source and date of collection, seeds collected later in the season have slightly better germination (Payne, 1957)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4" (Deitschman, 1974); Soil surface (Stark, 1966); 0-15 mm, will not emerge from 25 mm (Goodwin, 1956)  
PLANTING TIME: Fall or winter (Deitschman, 1974); Spring (Stark, 1966); Fall or spring (Shepherd, 1937)  
EXPOSURE: Sun (Sutton & Johnson, 1974)

SOIL TEXTURE: Coarse to fine (Sutton & Johnson, 1974)  
SOIL pH: 6.5-7.5 (Sutton & Johnson, 1974)  
SOIL DEPTH: Moderate to deep (Sutton & Johnson, 1974); 20-60+" (Stark, 1966)  
SOIL MOISTURE: Dry (Sutton & Johnson, 1974)  
PRECIPITATION: 8+" (20 cm) (Sutton & Johnson, 1974); 8-14+" (Stark, 1966)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Well-drained (Sutton & Johnson, 1974)  
NURSERY PLANTING: Mulch with light straw (Deitschman, 1974)  
FIELD PLANTING: Thrives with added nitrogen and water (Stark, 1966); Field germination Feb 1-Apr 30 (Goodwin, 1956)

*ARTEMISIA TRIDENTATA VASEYANA* (Rydb.) Beetle  
(Mountain Big Sagebrush)

FAMILY: Asteraceae  
LIFEFORM: Native evergreen shrub 4.9-27.4 cm tall (Winward & Tisdale, 1977)  
FRUIT: An achene, seeds weigh approx 0.000258 g (Winward & Tisdale, 1977)

#### PRETREATMENT

STRATIFICATION AND SCARIFICATION: Moist chill at 1-3°C for 40-50 days (McDonough & Harniss, 1974b)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 20°C or alternating at 20°C day and 2°C night (McDonough & Harniss, 1974a)  
MOISTURE: Moist (McDonough & Harniss, 1974a)  
LIGHT: Light has limited positive effect (McDonough & Harniss, 1974b)  
GERMINATIVE CAPACITY: 94% in 30 days (McDonough & Harniss, 1974a&b)  
COMMENTS: Both acid scarification and gibberellic acid promote germination (McDonough & Harniss, 1974b)

*ATRIPLEX CANESCENS* (Pursh) Nutt.  
(Fourwing Saltbush)

FAMILY: Chenopodiaceae  
LIFEFORM: Native shrub, 20-250 cm tall (Harrington, 1964)  
FRUIT: A utricle with four wings 5-23 mm wide (Springfield, 1969)

#### PROCUREMENT

SEEDS/LB: Dewinged 13,000-148,000--avg 52,000, intact 22,500 (Foiles, 1974); Intact 7,800-54,900 (Springfield, 1969); 10,500-25,600 (Swingle, 1939)  
SEED MATURITY: Oct (Foiles, 1974); Aug-Sep MT (Gamrath, 1972); Oct 20-Mar 1 UT (Plummer, et al., 1968); Late summer to fall (Swingle, 1939)

METHOD OF COLLECTION: Shake or hand strip seeds into bags, baskets, or onto canvas, also vacuum harvested (Foiles, 1974)  
METHOD OF CLEANING: Hammermill and fan (Foiles, 1974; Plummer et al., 1968); Hammermill at 1,500 rpm with 1/4" wire mesh (Hervey & Boyd, 1953)

#### PRETREATMENT

METHOD OF STORAGE: Store in cloth bags in unheated warehouse (Foiles, 1974; Springfield, 1968c); Store in sealed containers at 70°F (Hervey & Boyd, 1953; King, 1947)  
DURATION OF GOOD VIABILITY: 6-7 years (Foiles, 1974; Springfield, 1968c); Retention of good viability may be influenced by the year seeds were collected (Springfield, 1968a); Hammermilling seed may increase duration of good viability (Hervey & Boyd, 1953); 5 years (King, 1947)  
STRATIFICATION AND SCARIFICATION: 10 months afterripening at storage conditons (Foiles, 1974; Springfield, 1969); Germination energy and capacity improved by heavy scarification (Gerard, 1965; Nord & Whitacre, 1957); Soak seeds in sulfuric acid for 40 minutes (Gerard, 1965); Germination may be inanced by leaching salts from seeds with water for 2 hours (Twitchell, 1955); Soak seeds in sulfuric acid for 60 minutes (Housley, 1952); Moist chill at 5°C for 12 weeks, dry storage negates stratification requirement (King, 1947)

#### LABORATORY GERMINATION

TEMPERATURE: California strain alternating 75°F day and 65°F night, New Mexico strain constant at 60-65°F, Utah strain alternating at 38°F day and 32°F night (Foiles, 1974)  
MOISTURE: Moist (Aldon, 1970b; Hervey & Boyd, 1953); Lower moisture limit for germination 11 atmospheres of negative pressure, optimum moisture level 0 atmospheres (Springfield, 1969; Springfield, 1966); Best when relative humidity is 60-98% (Gerard, 1965)  
LIGHT: Light neither necessary nor inhibitory (Springfield, 1969); Short periods of light and dark may inhibit germination (Gerard, 1965)  
GERMINATIVE ENERGY: California strain 22% in 5 days, New Mexico strain 54-68% in 6-11 days, Utah strain 48% in 20 days (Foiles, 1974)  
GERMINATIVE CAPACITY: California strain 44% in 30 days, New Mexico strain 70-94% in 30-34 days, Utah strain 53% in 50 days (Foiles, 1974); 20% in 7 days CA (Williams et al., 1974); 44% ID (King, 1947); 17% ID (Glazebrook, 1941); 22-43% (Swingle, 1939)  
COMMENTS: Germinative characteristics vary with the seed source (Foiles, 1974; Gerard, 1965; Springfield, 1964); Smallestutricles have highest percentage of fill (Gamrath, 1972); High percentage of empty seeds,

germination inhibited by deficient aeration (Springfield, 1969); Dewinging improves germination, chloride and other soluble minerals may inhibit germination, thiourea at 3% inhibits germination (Gerard, 1965); Tetrazolium staining works well to determine viability (Boyd, 1954); Potassium nitrate does not improve germination (Hervey & Boyd, 1953; Housley, 1952)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/2" (Foiles, 1974; Nord et al., 1971); Best emergence from 1 cm but will emerge from 2 cm (Williams et al., 1974); 1/2-1" (Springfield, 1969; Springfield & Bell, 1967); 0-1/2" (Cassady, 1937)  
PLANTING TIME: Just prior to dependable moisture, fall or winter (Kay et al., 1977a); Usually spring or summer (Foiles, 1974); Spring (Stark, 1966)  
EXPOSURE: Sun (Foiles, 1974); Sun or shade (Woodmansee, 1969); Sun or valley bottom (Stark, 1966)  
SOIL TEXTURE: Medium to fine (Stark, 1966)  
SOIL pH: High alkaline tolerance (Stark, 1966)  
SOIL DEPTH: Deep (Stark, 1966)  
SOIL MOISTURE: Dry slopes, flats, and washes (Stark, 1966)  
PRECIPITATION: 6-10" or less (Stark, 1966)  
ORGANIC MATTER: Best reproduction in mulch (Woodmansee, 1969)  
GREENHOUSE PLANTING: Detailed vegetative propagation techniques (Wiesner & Johnson, 1977); Germinates well in vermiculite (Hervey & Boyd, 1953)  
NURSERY PLANTING: Broadcast seed and cover with 1/8-1/4" sand then roll, seedlings susceptible to damping off, birds, and rodents (Foiles, 1974)  
FIELD PLANTING: It is important to plant site adapted strains, mulching improves establishment (Foiles, 1974); Soil moisture should be at least 14% by weight or between 1/3 and 2 atmospheres tension (Aldon, 1972); 4-6 week old transplants in 2x2x3 plant bands have been successfully field planted (Aldon, 1970a&b); Natural germination is erratic and dependent upon adequate moisture and proper timing of precipitation (Woodmansee, 1969); Emergence and survival are reduced by high soil temperatures (Sosebee & Herbel, 1969; Sosebee, 1966); Seedlings are susceptible to frost (Stark, 1966)

<p><i>ATRIPLEX CONFERTIFOLIA</i> (Terr. &amp; Frem.) Wats. (Shadscale Saltbush)</p>
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FAMILY: Chenopodiaceae  
LIFEFORM: Native shrub 20-100 cm tall (Harrington, 1964)  
FRUIT: A utricle with foliose bracts 5-12 mm long (Blauer et al., 1976)



#### PROCUREMENT

SEEDS/LB: 29,500-126,000--avg 65,000 (Foiles, 1974); 64,920 (Plummer et al., 1968); 15,200 (Swingle, 1939)  
SEED MATURITY: Oct-Nov UT (Foiles, 1974); Oct 15-May 1 UT (Plummer et al., 1968); Late summer (Swingle, 1939)  
METHOD OF COLLECTION: Shake or hand strip into bags, basket, or onto canvas, also vacuum harvested (Foiles, 1974)  
METHOD OF CLEANING: Hammermill, fan (Foiles, 1974); Fan (Plummer, et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: Store in cloth bags in unheated warehouse (Foiles, 1974)  
DURATION OF GOOD VIABILITY: 6-7 years (Foiles, 1974); Less than 5 years (King, 1947)  
STRATIFICATION AND SCARIFICATION: 6 months afterripening under storage conditions (Foiles, 1974); 3 months afterripening at 70°F (Hussain, 1966)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating at 38°F day and 32°F night (Foiles, 1974); Alternating at 85°F day and 65°F night (Hussain, 1966)  
GERMINATIVE ENERGY: 12% in 365 days (Foiles, 1974)  
GERMINATIVE CAPACITY: 25% in 1,460 days (Foiles, 1974); 1-5% (Hussain, 1966); 0-21% (Swingle, 1939)  
COMMENTS: Will germinate in 1% salt solution but germinates best in 0% salt; seed viability varies with seed source (Hussain, 1966); Bracteoles enclosing seed will not permit germination, seed also contains a strong chemical germination inhibitor which is water soluble (Vest & Cottam, 1953)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/2" (Foiles, 1974)  
PLANTING TIME: Just prior to dependable moisture, usually spring or summer (Foiles, 1974; Kennedy, 1900)  
SOIL TEXTURE: Medium to fine (Sutton & Johnson, 1974)  
SOIL pH: 7.5-9.0 (Sutton & Johnson, 1974); high alkaline tolerance (Stark, 1966)  
SOIL DEPTH: Deep to moderate (Sutton & Johnson, 1974)  
SOIL MOISTURE: Dry (Stark, 1966); Should be moist for germination and establishment (Kennedy, 1900)  
PRECIPITATION: 4-8" (10-20 cm) (Stark, 1966)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Well-drained, some periods of standing water (Sutton & Johnson, 1974), 25-60% saturation (Stark, 1966)  
NURSERY PLANTING: Broadcast seed and cover with 1/8" soil and 1/4" sand then roll, seedlings susceptible to damping-off, birds, and rodents (Foiles, 1974)  
FIELD PLANTING: Mulching usually improves establishment (Foiles, 1974); Bracteoles must be removed from seed and seeds

leached with water before planting (Vest & Cottam, 1953); Use of containerized seedlings improves establishment (Kennedy, 1900)

*ATRIPLEX CORRUGATA* S. Wats.  
(Mat Saltbush)

FAMILY: Chenopodiaceae  
LIFEFORM: Native half shrub 10-20 cm tall (Harrington, 1964)  
FRUIT: A utricle with bracts 4-6 mm wide (Blauer et al., 1975)

#### PROCUREMENT

SEEDS/LB: 100,900 (Blauer et al., 1975)  
SEED MATURITY: May 15-Aug 15 (Blauer et al., 1975)

#### CULTURAL PRACTICES

PLANTING DEPTH: Press into surface (Kennedy, 1900)  
PLANTING TIME: Late spring or summer when ground is warm (Kennedy, 1900)  
EXPOSURE: Sun (Blauer et al., 1975)  
SOIL TEXTURE: Fine to medium (Blauer et al., 1975)  
SOIL pH: Salt tolerant up to 13,000 ppm (Blauer et al., 1975)  
SOIL MOISTURE: Dry (Blauer et al., 1975); Should be moist for germination and establishment (Kennedy, 1900)  
FIELD NURSERY: Use of containerized seedlings will result in a more consistent establishment (Kennedy, 1900)

*ATRIPLEX NUTTALLII* S. Wats.  
(Nuttall Saltbush)

FAMILY: Chenopodiaceae  
LIFEFORM: Native half shrub 20-50 cm tall (Harrington, 1964)  
FRUIT: A utricle with several small bracts 4-7 mm long (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 100,000-119,000--avg 111,500 (Foiles, 1974); 65,908-91,980 (McLean, 1953)  
SEED MATURITY: Nov-Dec UT (Foiles, 1974); Sep WY (Vosler, 1962)' Sep 25-Oct 14 CANADA (McLean, 1953)  
METHOD OF COLLECTION: Shake or hand strip into bags, basket, or onto canvas; also vacuum harvested (Foiles, 1974)  
METHOD OF CLEANING: Hammermill and fan (Foiles, 1974)

#### PRETREATMENT

METHOD OF STORAGE: Store in cloth bags in unheated warehouse (Foiles, 1974)

DURATION OF GOOD VIABILITY: 6-7 years (Foiles, 1974)

STRATIFICATION AND SCARIFICATION: 3 months afterripening under storage conditions (Foiles, 1974); Moist chill at 5°C for 4 days (McLean, 1953)

#### LABORATORY GERMINATION

TEMPERATURE: Utah strain alternating at 38°F day and 32°F night (Foiles, 1974); Alternating at 30°C day and 20°C night (McLean, 1953)

MOISTURE: Moist (McLean, 1953)

GERMINATIVE ENERGY: 28% in 60 days (Foiles, 1974); 6-40% in 30 days (Vosler, 1962); 40% in 6 days (McLean, 1953)

GERMINATIVE CAPACITY: 36% in 150 days (Foiles, 1974); 6.2-61% in 21 days (McLean, 1953); 65% (Swingle, 1939)

COMMENTS: High concentrations of NaOH have little effect on germination (Vosler, 1962); Only 25% of the seed collected contained viable embryos, germination ability varies widely with seed source (McLean, 1953); Seeds heavily attacked by insect larvae (McLean, 1953)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/2" (Foiles, 1974; Nelson, 1904); Shallow or at surface, emergence decreases rapidly below 1/2" (McLean, 1953)

PLANTING TIME: Just prior to dependable moisture, usually spring or summer (Foiles, 1974); Spring (McLean, 1953); Spring, soil should be warm (Kennedy, 1900)

EXPOSURE: Sun (Foiles, 1974; Stark, 1966)

SOIL TEXTURE: Coarse to medium on poorly developed soils (Stark, 1966); Medium to fine textured, no real textural preference (Vosler, 1962); Mostly heavy, fine textured soils (McLean, 1953)

SOIL pH: High alkaline tolerance, slight saline-alkaline tolerance (Stark, 1966); 6.6-8.1, 0.29-3.468% soluble salt (McLean, 1953)

SOIL DEPTH: Deep, 36-60+" (Stark, 1966; McLean, 1953)

SOIL MOISTURE: Dry hills (Stark, 1966); Moist for germination and establishment (Nelson, 1904)

PRECIPITATION: 4-10" (Stark, 1966)

NURSERY PLANTING: Broadcast seed and cover with 1/8" soil and 1/4" sand then roll, seedlings susceptible to damping-off, birds, and rodents (Foiles, 1974)

FIELD PLANTING: Mulching improves establishment (Foiles, 1974); Use of containerized seedlings improves establishment (Kennedy, 1900)

*ATRIPLEX NUTTALLII CUNEATA* (Nelson) H. & C.  
(Castlevalley Clover Saltbush)

SYNONYMY: *Atriplex nuttallii*, *Atriplex cuneata*

FAMILY: Chenopodiaceae

LIFEFORM: Native half shrub 20-50 cm tall (Harrington, 1964)

FRUIT: A utricle with bracts 5-9 mm wide (Blauer et al., 1976)

#### PROCUREMENT

SEEDS/LB: 81,660 (Blauer et al., 1976)

SEED MATURITY: Jun 1-Aug 20 UT (Blauer et al., 1976)

METHOD OF CLEANING: Hammermill and fan (Blauer et al., 1976)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 42% (Swingle, 1939)

#### CULTURAL PRACTICES

PLANTING DEPTH: Press seed into surface (Kennedy, 1900)

PLANTING TIME: Late spring or summer when ground is warm (Kennedy, 1900)

SOIL pH: Highly alkali tolerant (Kennedy, 1900)

SOIL MOISTURE: Moist for germination and establishment (Kennedy, 1900)

FIELD PLANTING: Use of containerized seedlings improves establishment (Kennedy, 1900)

*ATRIPLEX NUTTALLII GARDNERI*  
(Mog.) Hull & Clements  
(Gardner Saltbush)

SYNONYMY: *Atriplex nuttallii*, *Atriplex gardneri*

FAMILY: Chenopodiaceae

LIFEFORM: Native half shrub 20-50 cm tall (Harrington, 1964)

FRUIT: A utricle with bracts 3-6 mm long (Blauer et al., 1976)

#### PROCUREMENT

SEEDS/LB: 111,450 (Plummer et al., 1968)

SEED MATURITY: Sep 10-Mar 1 UT (Plummer et al., 1968)

METHOD OF CLEANING: Fan (Plummer et al., 1968)

#### PRETREATMENT

DURATION OF GOOD VIABILITY: 5 years (Plummer et al., 1968)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 60-65°F (Nord et al., 1971)

GERMINATIVE CAPACITY: 10% (Nord et al., 1971)



#### CULTURAL PRACTICES

PLANTING DEPTH: 1/2" (Nord et al., 1971)  
PLANTING TIME: Late spring or summer when ground is warm (Kennedy, 1900)  
SOIL TEXTURE: Fine (Blauer et al., 1976)  
SOIL SALINITY: Up to 5,500 ppm salt (Blauer et al., 1976)  
SOIL MOISTURE: Dry (Blauer et al., 1976); Moist for germination and establishment (Kennedy, 1900)  
FIELD PLANTING: Use of containerized seedlings improves establishment (Kennedy, 1900)

*ATRIPLEX OBOVATA* Moq.  
(Broadscale Saltbush)

FAMILY: Chenopodiaceae  
LIFEFORM: Native half shrub 20-50 cm tall (Harrington, 1964)  
FRUIT: A utricle with bracts 5-9 mm broad (Blauer et al., 1975)  
SEED: 1-5 mm wide (Edgar & Springfield, 1977)

#### PROCUREMENT

SEEDS/LB: 207,630 (Blauer et al., 1975)  
SEED MATURITY: Aug 20-Sep 20 UT (Blauer et al., 1975)

#### PRETREATMENT

STRATIFICATION AND SCARIFICATION: Afterripen at 23°C for 3 1/2 months (Edgar & Springfield, 1977)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 20°C (Edgar & Springfield, 1977)  
LIGHT: Best in continuous light but a brief daily exposure is adequate to promote germination (Edgar & Springfield, 1977)  
GERMINATIVE ENERGY: 8-38% in 3 days (Edgar & Springfield, 1977)  
GERMINATIVE CAPACITY: 10-48% in 13 days (Edgar & Springfield, 1977)  
COMMENTS: Germination rate promoted by: thiourea and dusting with activated charcoal (Edgar & Springfield, 1977; Kay, 1974); Potassium nitrate and stratification (Edgar & Springfield, 1977; Blauer et al., 1975); Soaking in water (Edgar & Springfield, 1977); Scarification (Edgar & Springfield, 1977); Gibberillic acid (Edgar & Springfield, 1977)

#### CULTURAL PRACTICES

PLANTING DEPTH: Press into surface (Kennedy, 1900)  
PLANTING TIME: Spring (Edgar & Springfield, 1977); Spring or summer when ground is warm (Kennedy, 1900)  
EXPOSURE: Sun (Blauer et al., 1975)

SOIL TEXTURE: Coarse (Blauer et al., 1975)  
SOIL pH: Found on alkaline soils (Edgar & Springfield, 1977)  
SOIL SALINITY: Found on saline soils (Edgar & Springfield, 1977); 165-4,900 ppm salt (Blauer et al., 1975)  
SOIL MOISTURE: Dry (Blauer et al., 1975); Moisture for germination and establishment (Kennedy, 1900)  
FIELD PLANTING: Use of containerized seedlings improves establishment (Kennedy, 1900)

*BACCHARIS EMORYI* A. Gray  
(Emory Baccharis)

FAMILY: Asteraceae  
LIFEFORM: Native evergreen shrub 1-4 m tall (Harrington, 1964)  
FRUIT: An achene (Harrington, 1964)

#### PRETREATMENT

STRATIFICATION AND SCARIFICATION: None necessary (Swingle, 1939)

#### CULTURAL PRACTICES

PLANTING TIME: Fall or spring (Swingle, 1939)  
EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Medium (Stark, 1966)  
SOIL SALINITY: Often in saline soil (Harrington, 1964)  
SOIL DEPTH: Deep (Stark, 1966)  
SOIL MOISTURE: Moist (Stark, 1966)  
SOIL DRAINAGE: Well-drained (Stark, 1966)

*BACCHARIS GLUTINOSA* Pursh  
(Seep-willow)

FAMILY: Asteraceae  
LIFEFORM: Native evergreen shrub 3-12 ft tall (Vines, 1960)  
FRUIT: An achene (Vines, 1960)

#### PRETREATMENT

METHOD OF STORAGE: Store dry at 40°F (Horton et al., 1960)  
DURATION OF GOOD VIABILITY: Up to 1 year at 70°F and up to 2 years at 40°F (Horton et al., 1960)  
STRATIFICATION AND SCARIFICATION: None necessary (Swingle, 1939)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 26-45% (Horton et al., 1960)  
COMMENTS: Seed germination unsuccessful (Stark, 1966); Germination highly variable (Horton et al., 1960)

#### CULTURAL PRACTICES

PLANTING TIME: Fall or spring (Swingle, 1939)  
EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Fine (Stark, 1966)  
SOIL pH: Alkali tolerant (Stark, 1966)  
SOIL MOISTURE: Moist (Stark, 1966); Usually  
along stream banks (Vines, 1960)  
DRAINAGE: Well-drained (Stark, 1966)  
FIELD PLANTING: Reproduces well from cuttings  
(Vines, 1960)

*BERBERIS VULGARIS* L.  
(Common Barberry)

FAMILY: Berberidaceae  
LIFEFORM: Introduced shrub to 2.5 m tall  
(Harrington, 1964)  
FRUIT: A few-seeded berry 8-12 mm long  
(Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 41,215 (Swingle, 1939)  
SEED MATURITY: Late fall (Swingle, 1939)

#### PRETREATMENT

METHOD OF STORAGE: Dry (Swingle, 1939)  
STRATIFICATION AND SCARIFICATION: Sow in soil  
over winter (Adams, 1927)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 86% in 295 days (Adams,  
1927)

#### CULTURAL PRACTICES

PLANTING TIME: Fall or spring (Swingle, 1939);  
Fall (Adams, 1927)

*BRICKELLIA CALIFORNICA* (T. & G.) Gray  
(California Brickellia)

FAMILY: Asteraceae  
LIFEFORM: Native shrub 25-100 cm tall  
(Harrington, 1964)  
FRUIT: An achene (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 599,000 (Mirov & Kraebel, 1939;  
Swingle, 1939)  
SEED MATURITY: Aug-Oct CA (Mirov & Kraebel,  
1939; Swingle, 1939)

#### PRETREATMENT

STRATIFICATION AND SCARIFICATION: No treat-  
ment necessary (Mirov & Kraebel, 1939;  
Swingle, 1939)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 36% in 3 days (Mirov &  
Kraebel, 1939)  
COMMENTS: Has been successfully germinated  
(Stark, 1966)

#### CULTURAL PRACTICES

EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Fine to coarse (Stark, 1966)  
SOIL DEPTH: Moderate to deep (Stark, 1966)  
SOIL MOISTURE: Dry (Stark, 1966)

*CEANOTHUS FENDLERI* A. Gray  
(Fendler Ceanothus)

FAMILY: Rhamnaceae  
LIFEFORM: Native shrub 20-80 cm tall  
(Harrington, 1964)  
FRUIT: A 3-lobed capsule 4-5 mm wide  
(Harrington, 1964)

#### PROCUREMENT

SEED MATURITY: Aug-Dec AZ (Reed, 1974)  
METHOD OF COLLECTION: Only from vigorous  
plants, tie cloth bags over green seed  
pod clusters until seed is ejected (Reed,  
1974)  
METHOD OF CLEANING: Screen and fan (Reed,  
1974)

#### PRETREATMENT

METHOD OF STORAGE: Sealed containers at 40°F  
(Reed, 1974)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 16% (Reed, 1974;  
Swingle, 1939)

#### CULTURAL PRACTICES

PLANTING DEPTH: Twice the greatest diameter  
of seed (Reed, 1974)  
PLANTING TIME: Spring (Reed, 1974)  
EXPOSURE: Sun or shade (Sutton & Johnson,  
1974)  
SOIL TEXTURE: Light (Reed, 1974); Medium to  
coarse (Sutton & Johnson, 1974)  
SOIL pH: 6.0-7.0 (Sutton & Johnson, 1974)  
SOIL DEPTH: Shallow to moderate (Sutton &  
Johnson, 1974)  
SOIL MOISTURE: Dry (Sutton & Johnson, 1974)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Well-drained (Reed, 1974; Sutton &  
Johnson, 1974)  
GREENHOUSE PLANTING: Sensitive to damping-  
off (Reed, 1974)

*CEANOOTHUS MARTINII* M. E. Jones  
(Martin Ceanothus)

FAMILY: Rhamnaceae  
LIFEFORM: Native evergreen shrub 1-2 ft tall  
(Sutton & Johnson, 1974)  
FRUIT: A three-lobed capsule (Harrington,  
1964)

PROCUREMENT

SEEDS/LB: 82,845 (Plummer et al., 1968)  
SEED MATURITY: Jul 10-Aug 15 (Plummer et al.,  
1968)  
METHOD OF COLLECTION: Handpick into con-  
tainers (Plummer et al., 1968)  
METHOD OF CLEANING: Dry, fan, and float then  
fumigate (Plummer et al., 1968)

PRETREATMENT

DURATION OF GOOD VIABILITY: 5 years (Plummer  
et al., 1968)

CULTURAL PRACTICES

EXPOSURE: Sun (Sutton & Johnson, 1974)  
SOIL TEXTURE: Medium (Sutton & Johnson, 1974)  
SOIL pH: 6.5 (Sutton & Johnson, 1974)  
SOIL DEPTH: Deep (Sutton & Johnson, 1974)  
SOIL MOISTURE: Dry (Sutton & Johnson, 1974)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Well-drained (Sutton & Johnson,  
1974)

*CEANOOTHUS VELUTINUS* Dougl.  
(Snowbrush Ceanothus)

FAMILY: Rhamnaceae  
LIFEFORM: Native shrub 1-3 m tall  
(Harrington, 1964)  
FRUIT: A three-lobed capsule 3-6 mm long  
(Harrington, 1964)

PROCUREMENT

SEEDS/LB: 61,400-152,000--avg 94,000 (Reed,  
1974); 124,275 (Plummer et al., 1968);  
71,000 (Swingle, 1939)  
SEED MATURITY: Aug UT; Jul-Sep OR; Aug 10-  
Sep 10 MT; Jul 15-Aug 1 ID (Reed, 1974);  
Aug 1-Aug 30 UT (Plummer et al., 1968);  
Jul-Aug NV (Stark, 1966); Jul-Aug  
(Swingle, 1939)  
METHOD OF COLLECTION: Only from vigorous  
plants, tie cloth bags over green seed pod  
clusters until seed is ejected (Reed,  
1974); Handpick seed into containers  
(Plummer et al., 1968)  
METHOD OF CLEANING: Screen and fan (Reed,  
1974); Dry, fan, and float (Plummer  
et al., 1968)

PRETREATMENT

METHOD OF STORAGE: Sealed containers at 40°F  
(Reed, 1974)

DURATION OF GOOD VIABILITY: 5 years (Plum-  
mer et al., 1968); 12 years (Quick &  
Quick, 1961)

STRATIFICATION AND SCARIFICATION: Hot water  
soak to 194°F then cool or moist chill at  
34-41°F for 63-84 days (Reed, 1974); Hot  
water soak 80-85 minutes or soak in  
sulfuric acid for 30-60 minutes then  
moist chill at 3-5°C for 2 months (Heit,  
1970); Moist chill at 34-41°F for 63-84  
days, scarification may be beneficial  
(Peterson, 1953); Hot water soak and moist  
chill for 3 months (Swingle, 1939; Mirov &  
Kraebel, 1937); Hot water soak at 80°C,  
cool, then moist chill at 2.5°C for 90  
days (Quick, 1935)

LABORATORY GERMINATION

TEMPERATURE: Alternating 30°C day and 20°C  
night (Heit, 1970)  
GERMINATIVE ENERGY: 9% in 22 days (Peterson,  
1953)  
GERMINATIVE CAPACITY: 82% (Reed, 1974); 79%  
in 7 days (Heit, 1970); 11% in 35 days  
(Peterson, 1953); 68% (Swingle, 1939); 68%  
in 100 days (Mirov & Kraebel, 1937); 68%  
in 14 days (Quick, 1935)  
COMMENTS: Germination may be enhanced by fire  
in nature (Curtis, 1952)

CULTURAL PRACTICES

PLANTING DEPTH: Twice the greatest diameter  
of seed (Reed, 1974)  
PLANTING TIME: Fall (Heit, 1970); Summer  
(Stark, 1966)  
EXPOSURE: Sun (Sutton & Johnson, 1974; Stark,  
1966)  
SOIL TEXTURE: Medium to coarse (Sutton &  
Johnson, 1974)  
SOIL pH: 5.5-7.0 (Sutton & Johnson, 1974);  
Near acid (Stark, 1966)  
SOIL DEPTH: Deep (Sutton & Johnson, 1974);  
20-60+" (Stark, 1966)  
SOIL MOISTURE: Dry (Sutton & Johnson, 1974)  
PRECIPITATION: 10-14+" (Stark, 1966)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Well-drained (Sutton & Johnson,  
1974)  
GREENHOUSE PLANTING: Sensitive to damping-off  
(Reed, 1974)  
NURSERY PLANTING: Vegetative propagation with  
2-3" branch tips in a frame with bottom  
heat, use root producing hormone (Mirov &  
Kraebel, 1939)  
FIELD PLANTING: Minimum soil temperature for  
germination 45-65°C and optimum of 80-  
105°C with lethal at approx 120°C in  
nature (Gratkowski, 1962)

*CERATOIDES LANATA* (Pursh) J. T. Howell  
(Winterfat)

SYNONYMY: *Eurotia lanata*  
FAMILY: Chenopodiaceae  
LIFEFORM: Native shrub 30-100 cm tall  
(Harrington, 1964)



FRUIT: A one-seeded utricle with bracts 4-8 mm long (Harrington, 1964)  
SEED: A nutlet enclosed in two bracts with fluffy white hairs (Springfield, 1974a)

#### PROCUREMENT

SEEDS/LB: 126,000-210,000 (Eddleman, 1977); 111,000-208,000 (Springfield, 1974a); 112,275 (Plummer et al., 1968); 54,400 (Swingle, 1939)  
SEED MATURITY: Sep 30-Nov 11 MT (Eddleman, 1977); Oct 15-Nov 15 (Springfield, 1974a); Oct 5-Dec 30 UT (Plummer et al., 1968); Late summer (Swingle, 1939)  
METHOD OF COLLECTION: Head cutter (Eddleman, 1977); Hand strip (Stevens et al., 1977); Hand strip or use vacuum harvester (Springfield, 1974a); Hand strip or use seed strippers (Plummer et al., 1968);  
METHOD OF CLEANING: Hammermill with 5/16" screen at 1,000-1,200 rpm (Stevens et al., 1977); Removal of seed from hairy utricle not advised (Hodgkinson, 1975); Hammermill at 850 rpm, fan with 7/64" upper screen and 1/16" lower screen (Springfield, 1974a); Hammermill (Hilton, 1941)

#### PRETREATMENT

METHOD OF STORAGE: Do not remove seeds from bracts (Stevens et al., 1977); Store at 40°F in sealed containers (Springfield, 1974a); In sealed containers at 34-42°F (Springfield, 1974b; Springfield, 1968b; Workman & West, 1967); No advantage to cold storage (Housley, 1952)  
DURATION OF GOOD VIABILITY: 8 years at 34-42°F (Springfield, 1974b); 1 year (Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Should undergo short period of cool or freezing temperature before or after harvest (Stevens et al., 1977); Afterripen 9-13 weeks from collection for best germination (Springfield, 1972b)

#### LABORATORY GERMINATION

TEMPERATURE: Best at a constant 10°C (Moyer & Lang, 1976); Alternating 86°F day and 68°F night (Springfield, 1974a); Constant between 50-80°F (Springfield, 1972a); Constant between 55-75°F (Springfield, 1969); Constant between 42-72°F (Hilton, 1941)  
MOISTURE: Best germination in moist environment (Hodgkinson, 1975; Springfield, 1968d); Germination decreases as moisture stress increases (Springfield, 1974a, 1971, 1968d; Al-Rabbat, 1962); Ability to withstand moisture stress increases as temperature decreases; lower limit of germination is at -15 atmospheres of moisture stress (Springfield, 1968d)  
LIGHT: Light is neither necessary nor inhibitory (Springfield, 1974a; Hilton, 1941)  
GERMINATIVE ENERGY: 8-42% in 6 days (Moyer & Lang, 1976); 93% in 5 days (Springfield, 1974a)  
GERMINATIVE CAPACITY: 18-65% in 15 days (Moyer & Lang, 1976); 94-100% in 5 days

(Hodgkinson, 1975); 94% in 29 days (Springfield, 1974a); 83% in 5 days (Al-Rabbat, 1962); 72-86% (Swingle, 1939)  
COMMENTS: Stratification requirements and temperature requirements may vary with seed source (Moyer & Lang, 1976); Large--2.9-3.6 mm long--and medium--2.5-3.1 mm long--sized seeds germinate better and faster than small--2.0-2.6 mm long--seed (Springfield, 1973b); Chloride salts cause greater reduction in germination than sulfate salts (Clark & West, 1971); Upper salt concentration for germination approx 2% (Clark & West, 1971; Hilton, 1941); Upper salt concentration for germination 3% (Workman & West, 1969); No benefit from potassium nitrate (Housley, 1952)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/16-1/4" (Stevens et al., 1977); 1/16-1/8" (Springfield, 1974a); 1/16" (Springfield, 1971); On or near surface when soil moisture is over field capacity (Springfield, 1970a; Al-Rabbat, 1962); 1/4" (Statler, 1967); Will not emerge below 1/2", seedling mortality greatest at surface planting (Al-Rabbat, 1962)  
PLANTING TIME: Late fall-early winter (Hodgkinson, 1975); Spring (Statler, 1967); Variable (Stark, 1966)  
EXPOSURE: Intolerant to shade, best in sun (Woodmansee & Potter, 1971)  
SOIL TEXTURE: Loamy soils (Stark, 1966)  
SOIL pH: 7.4-8.0 (Woodmansee & Potter, 1971); Subalkaline (Stark, 1966)  
SOIL DEPTH: Deep, 36-60" (Stark, 1966)  
PRECIPITATION: 6-19" (Stark, 1966)  
ORGANIC MATTER: Best reproduction in mulch (Woodmansee & Potter, 1971; Woodmansee, 1969)  
DRAINAGE: Well-drained (Stark, 1966)  
FIELD PLANTING: Exhibits strong ecotype variation, seedling vigor varies with seed source, tall-growing strains best suited for winter ranges, seeds should be sown in cool weather (Springfield, 1974a); Sensitive to deficient aeration (Springfield, 1971); Tolerant to competition (Woodmansee & Potter, 1971); Tolerance of seeds to NaCl during germination varies with the seed source (Workman & West, 1969, 1967); Compaction before planting increases emergence, increasing depth from 0-1/2" delays emergence 2-3 days, moisture stress had little effect on emergence (Al-Rabbat, 1962)

*CERCOCARPUS INTRICATUS* S. Wats.  
(Littleleaf Mountain Mahogany)

FAMILY: Rosaceae  
LIFEFORM: Native evergreen shrub 30-150 cm tall (Harrington, 1964)  
FRUIT: An achene (6-7 mm long) with a hairy style (2-4 cm long) (Harrington, 1964)

#### PROCUREMENT

SEED MATURITY: Jul 10-Jul 25 UT (Plummer et al., 1968)  
METHOD OF COLLECTION: Knock from bushes into hopper (Plummer et al., 1968)  
METHOD OF CLEANING: Hammermill, fan, Dybvig, dry, and fan (Plummer et al., 1968)

#### PRETREATMENT

DURATION OF GOOD VIABILITY: 10 years (Plummer et al., 1968)

#### CULTURAL PRACTICES

EXPOSURE: Sun (Sutton & Johnson, 1974)  
SOIL TEXTURE: Medium to coarse (Sutton & Johnson, 1974); Crevices in limestone (Stark, 1966)  
SOIL pH: 7.0-7.5 (Sutton & Johnson, 1974)  
SOIL DEPTH: Moderate (Sutton & Johnson, 1974)  
SOIL MOISTURE: Dry (Stark, 1966)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Well-drained (Sutton & Johnson, 1974)

*CERCOCARPUS LEDIFOLIUS* Nutt. ex T. & G.  
(Curleaf Mountain Mahogany)

FAMILY: Rosaceae  
LIFEFORM: Native shrub to small tree 7-8 m tall (Harrington, 1964)  
FRUIT: An achene (8-10 mm long) with a hairy style (4-7 mm long) (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 48,200-56,600--avg 51,900 (Deitschman et al., 1974a); 50,600 (Glazebrook, 1941); 42,000 (Swingle, 1939; Mirov & Kraebel, 1937)  
SEED MATURITY: Aug-Sep (Deitschman et al., 1974a); Jul 10-Sep 1 UT (Plummer et al., 1968); May-Jun (Swingle, 1939); May-Jun CA (Mirov & Kraebel, 1937)  
METHOD OF COLLECTION: Shake branches onto canvas or into hopper (Plummer et al., 1968)  
METHOD OF CLEANING: Hammermill, fan, and screen (Deitschman et al., 1974a); Hammermill, fan, Dybvig, dry, and fan (Plummer et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: Dry storage in ventilated containers in unheated warehouse (Deitschman et al., 1974a)  
DURATION OF GOOD VIABILITY: 5 years (Deitschman et al., 1974a); 10 years (Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Germination may be improved by a 20 minute soak in sulfuric acid and then soaked in 3% thiourea for 16 hours followed by moist chilling at 32-38°F for 36 days or at 41°F for 30-90 days (Deitschman et al., 1974a);

Soak in sulfuric acid for 20 minutes (Heit, 1970); Germination enhanced by 5 minute soak in sulfuric acid followed by a 4 hour soak in 3% thiourea (Liacos & Nord, 1961); Crack seed and then moist chill at 5°C for 12 weeks (Glazebrook, 1941)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 32-38°F (Deitschman et al., 1974a); Alternating at 30°C day and 10°C night (Heit, 1970, 1968)  
LIGHT: Does not require light (Heit, 1968)  
GERMINATIVE CAPACITY: 29-80% in 263-365 days (Deitschman et al., 1974a); 87% in 27 days (Heit, 1970); 44% (Swingle, 1939); 44% in 163 days (Mirov & Kraebel, 1937)  
COMMENTS: Dormancy may vary with ecotypes (Deitschman et al., 1974a); No significant increase in germination from addition of thiourea or potassium nitrate (Heit, 1970)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4-1/2" (Deitschman et al., 1974a)  
PLANTING TIME: Fall (Deitschman et al., 1974a); December (Stark, 1966)  
EXPOSURE: Sun (Sutton & Johnson, 1974)  
SOIL TEXTURE: Coarse to rocky (Sutton & Johnson, 1974); Sandy loam (Stark, 1966)  
SOIL pH: Near acid soils (6.0-7.0) (Sutton & Johnson, 1974)  
SOIL DEPTH: 20-60" (Sutton & Johnson, 1974); Deep to shallow (Stark, 1966)  
SOIL MOISTURE: Dry (Sutton & Johnson, 1974)  
PRECIPITATION: 12+" (30.5+ cm) (Sutton & Johnson, 1974)  
ORGANIC MATTER: No (Stark, 1966)  
DRAINAGE: Well-drained (Stark, 1966)  
NURSERY PLANTING: Seedbed should be kept moist until germination (Deitschman et al., 1974a)  
FIELD PLANTING: Mulch (Deitschman et al., 1974a)

*CERCOCARPUS MONTANUS* Raf.  
(True Mountain Mahogany)

FAMILY: Rosaceae  
LIFEFORM: Native shrub up to 3 m tall (Harrington, 1964)  
FRUIT: An achene (8-10 mm long) with a hairy style (6-10 cm long) (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 55,900-65,200--avg 59,000 (Deitschman et al., 1974a); 28,000-41,000 (Piatt, 1973); 41,600-42,000 (Swingle, 1939)  
SEED MATURITY: Aug-Sep (Deitschman et al., 1974a); Sep 15-Oct 5 CO (Smith & Bass, 1973); Jul 15-Sep 1 UT (Plummer et al., 1968); Summer (Swingle, 1939)  
METHOD OF COLLECTION: Shake onto canvas or into hopper (Deitschman et al., 1974a); Collect achenes in years when precipitation during the growing season is average



or above, germination rates may be 2-3 times higher in wet than dry years, northerly aspects are the most desirable exposures, largest and most viable achenes may be found on less fertile soils where mountain mahogany plants are not abundant (Smith & Bass, 1973; Smith, 1971)

METHOD OF CLEANING: Hammermill, fan, and screen (Deitschman et al., 1974a); Hammermill, fan, Dybvig, dry, and fan (Plummer et al., 1968); Hammermill at 1080 rpm with 3/16" screen mesh (Hervey & Boyd, 1953)

#### PRETREATMENT

METHOD OF STORAGE: Sealed container in refrigerator (Smith & Bass, 1973); Sealed container in refrigerator or freezer (Springfield, 1973a); Sealed container in refrigerator (Smith, 1941); Sealed container at 70°F (Hervey, 1955; Hervey & Boyd, 1953)

DURATION OF GOOD VIABILITY: 5 years (Deitschman et al., 1974a); 7 years (Smith & Bass, 1973); Year of collection may influence duration of good viability (Smith, 1971); 10 years (Plummer et al., 1968); Hammermilling seed reduces duration of good viability (Hervey & Boyd, 1953)

STRATIFICATION AND SCARIFICATION: Germination may be improved by a 20 minute soak in sulfuric acid and a soak in 3% thiourea for 16 hours then moist chill at 32-38°F for 36 days or at 41°F for 30-90 days (Deitschman et al., 1974a); Afterripen at 20°C for 5 months then at 5°C for 6 weeks then moist chill at 5°C for 2-3 weeks (Smith & Bass, 1973; Smith, 1971); Germination improved by a 10 minute soak in sulfuric acid (Heit, 1970); Germination may be improved by leaching with water (Moore, 1963); Germination improved by a 60 minute soak in sulfuric acid but not as well as by moist chilling seed at 31-41°F for 35-70 days (Boyd, 1954)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 20°C (Piatt, 1976); Constant at 32-38°F (Deitschman et al., 1974a); Alternating at 30°C day and 20°C night (Smith & Bass, 1973; Smith, 1971; Heit, 1970); Constant at 54-57°F (Springfield, 1973a)

MOISTURE: Best in saturated state, lower limit of moisture stress negative 7 bars, moisture stress more inhibitory at non-optimal temperature (Piatt, 1976)

LIGHT: Neither positively nor negatively affected by light (Piatt, 1976)

GERMINATIVE CAPACITY: 82-88% in 28 days (Piatt, 1976); 92% in 70 days (Deitschman et al., 1974a); 28% in 15 days (Heit, 1970); 3-62% (Swingle, 1939); 65% (Griswald, 1936)

COMMENTS: Temperature and moisture relations may vary with seed source (Piatt, 1976); Dormancy may vary with ecotypes (Deitschman et al., 1974a); Total germination may vary with seed source, large seeds germinate better (Piatt, 1973); Potassium

nitrate does not improve germination (Heit, 1970; Hervey & Boyd, 1953; Housley, 1952); Thiourea does not improve germination (Heit, 1970); Contains a water soluble germination inhibitor in the seed coat (Moore, 1963); Tetrazolium staining not satisfactory for determining viability (Boyd, 1954)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4-1/2" (Deitschman et al., 1974a)

PLANTING TIME: Fall (Deitschman et al., 1974a)

EXPOSURE: Sun (Sutton & Johnson, 1974); Seedlings need shade for survival (Woodmansee, 1969; Hervey, 1955)

SOIL TEXTURE: Coarse to rocky (Sutton & Johnson, 1974)

SOIL pH: 6.5-7.5 (Sutton & Johnson, 1974)

SOIL DEPTH: Deep (Sutton & Johnson, 1974)

SOIL MOISTURE: Dry (Sutton & Johnson, 1974)

ORGANIC MATTER: No (Sutton & Johnson, 1974); Best reproduction in mulch (Woodmansee, 1969; Hervey, 1955)

DRAINAGE: Well-drained (Sutton & Johnson, 1974)

GREENHOUSE PLANTING: Reproduces well by cuttings (Swingle, 1939)

NURSERY PLANTING: Seedbed should be kept moist until germination (Deitschman et al., 1974a)

FIELD PLANTING: Mulch (Deitschman et al., 1974a); Natural reproduction erratic, dependent upon adequate moisture and proper timing of precipitation (Woodmansee, 1969)

<p><i>CHRYSOTHAMNUS NAUSEOSUS</i> (Pall.) Britt. (Rubber Rabbitbrush)</p>
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FAMILY: Asteraceae

LIFEFORM: Native shrub 20-200 cm tall (Harrington, 1964)

FRUIT: An achene (5-5.5 mm long) with a pappus of hairs of the same length (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 445,000-483,000 (Eddleman, 1977); 649,000-745,000--avg 693,000 (Deitschman et al., 1974b); 335,000 (Mirov & Kraebel, 1937)

SEED MATURITY: Oct 15-Dec 30 UT (Plummer et al., 1968); Oct-Nov CA (Mirov & Kraebel, 1937)

METHOD OF COLLECTING: Shake or strip heads into container or onto canvas, or vacuum harvest (Deitschman et al., 1974b; Plummer et al., 1968)

METHOD OF CLEANING: Mechanical flail, clipper (1/13)/blank, seed blower (Eddleman, 1977); Hammermill (Deitschman et al., 1974b; Plummer et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: Store dry in cloth bags in unheated warehouse (Deitschman et al., 1974b)  
DURATION OF GOOD VIABILITY: 2 years (Deitschman et al., 1974b; Plummer et al., 1968)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 20°C (Eddleman, 1977); Constant at 33-38°F (Deitschman et al., 1974b)  
GERMINATIVE ENERGY: 50% in 2-4 days (Eddleman, 1977); 38% in 21 days (Deitschman et al., 1974b)  
GERMINATIVE CAPACITY: 94-99% (Eddleman, 1977); 63% in 120 days (Deitschman et al., 1974b); 36% in 3 days (Mirov & Kraebel, 1937)

#### CULTURAL PRACTICES

PLANTING TIME: Fall or winter (Deitschman et al., 1974b); Nov (Stark, 1966)  
EXPOSURE: Sun (Sutton & Johnson, 1974)  
SOIL TEXTURE: Sandy to clay loam (Stark, 1966)  
SOIL pH: 7.0-8.5 (Stark, 1966)  
SOIL SALINITY: Saline tolerant (Stark, 1966)  
SOIL DEPTH: Moderate (40-60") (Stark, 1966)  
SOIL MOISTURE: Dry (Stark, 1966); Phreatophytic (Stark, 1966)  
PRECIPITATION: 6-10" (15-25 cm) (Stark, 1966)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Well-drained (Sutton & Johnson, 1974)

*CHRYSOTHAMNUS VISCIDIFLORUS* (Hook.) Nutt.  
(Douglas Rabbitbrush)

FAMILY: Asteraceae  
LIFEFORM: Native shrub 10-240 cm tall (Harrington, 1964)  
FRUIT: An achene 3-4 mm long with a pappus of hairs of the same length (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 674,000-840,000--avg 782,000 (Deitschman et al., 1974b)  
SEED MATURITY: Fall, winter UT (Sutton & Johnson, 1974); Oct-Dec NV (Stark, 1966)  
METHOD OF COLLECTION: Shake branches or strip heads into container or onto canvas, or vacuum harvest (Deitschman et al., 1974b)  
METHOD OF CLEANING: Hammermill (Deitschman et al., 1974b)

#### PRETREATMENT

METHOD OF STORAGE: Store in cloth bags in unheated warehouse (Deitschman et al., 1974b)  
DURATION OF GOOD VIABILITY: 2 years (Deitschman et al., 1974b)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 20-30°C (Eddleman, 1977); Constant at 33-38°F (Deitschman et al., 1974b); Alternating at 22°C day and 17°C night (McDonough, 1969)  
LIGHT: Light may be beneficial (Eddleman, 1977)  
GERMINATIVE ENERGY: 50% in 2-3 days (Eddleman, 1977); 49% in 7 days (McDonough, 1969)  
GERMINATIVE CAPACITY: 92-97% (Eddleman, 1977); 60% in 300 days (Deitschman et al., 1974b); 98% in 28 days (McDonough, 1969)

#### CULTURAL PRACTICES

PLANTING TIME: Fall or winter (Deitschman et al., 1974b)  
EXPOSURE: Sun (Sutton & Johnson, 1974)  
SOIL TEXTURE: Medium to fine (Sutton & Johnson, 1974)  
SOIL pH: 7.0-8.5 (Sutton & Johnson, 1974)  
SOIL SALINITY: Salt tolerant (Stark, 1966)  
SOIL DEPTH: Deep (Sutton & Johnson, 1974)  
SOIL MOISTURE: Dry (Sutton & Johnson, 1974)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Well-drained (Sutton & Johnson, 1974)

*CHRYSOTHAMNUS VISCIDIFLORUS LANCEOLATUS*  
(Nutt.) H. & C.  
(Mountain Low Rabbitbrush)

FAMILY: Asteraceae  
LIFEFORM: Native shrub 20-50 cm tall (Harrington, 1964)  
FRUIT: An achene 3-4 mm long (Harrington, 1964)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 70°F (Griswald, 1936)  
MOISTURE: Moist (Griswald, 1936)  
GERMINATIVE CAPACITY: 86% in 49 days (Griswald, 1936)  
COMMENTS: Alternating moistening and drying of seed reduces germination (Griswald, 1936)

*CLEMATIS LIGUSTICIFOLIA* Nutt.  
(Western Virginbower)

FAMILY: Ranunculaceae  
LIFEFORM: Native woody vine 4-6 m tall (Harrington, 1964)  
FRUIT: An achene with style 4-5 cm long (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 300,000-328,000--avg 315,000 (Rudolf, 1974b); 93,000-329,150 (Swingle, 1939); 93,000 (Mirov & Kraebel, 1937)



SEED MATURITY: Oct-Dec CO & UT (Rudolf, 1974b); Oct 10-Dec 30 UT (Plummer et al., 1968); Fall (Swingle, 1939); Jun-Sep CA (Mirov & Kraebel, 1937)

METHOD OF COLLECTION: Hand strip or vacuum harvest (Rudolf, 1974b; Plummer et al., 1968)

METHOD OF CLEANING: Hammervill and fan (Rudolf, 1974b; Plummer et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: Dry (Swingle, 1939)

DURATION OF GOOD VIABILITY: 2 years (Rudolf, 1974b; Plummer et al., 1968)

STRATIFICATION AND SCARIFICATION: Moist chill at 33-40°F for 60-180 days (Rudolf, 1974b); Moist chill at 3-5°C for 2-6 months (Heit, 1968)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 60-70°F (Milstein & Milstein, 1976); Alternating at 86°F day and 68°F night (Rudolf, 1974b)

GERMINATIVE CAPACITY: Complete in 20-30 days (Milstein & Milstein, 1976); 11-84% in 200 days (Rudolf, 1974b); 11-84% (Swingle, 1939); 21% in 27 days (Mirov & Kraebel, 1937)

#### CULTURAL PRACTICES

PLANTING TIME: Fall (Rudolf, 1974b); Spring (Swingle, 1939)

EXPOSURE: Sun (Sutton & Johnson, 1974)

SOIL TEXTURE: Rocky loam (Stark, 1966)

SOIL pH: 7.0 (Sutton & Johnson, 1974)

SOIL DEPTH: Shallow to deep (Sutton & Johnson, 1974)

SOIL MOISTURE: Moist (Sutton & Johnson, 1974); along streams (Stark, 1966)

ORGANIC MATTER: Yes (Sutton & Johnson, 1974)

DRAINAGE: Well-drained (Sutton & Johnson, 1974)

*COLEOGYNE RAMOSISSIMA* Torr.  
(Blackbrush)

FAMILY: Rosaceae

LIFEFORM: Native shrub up to 2 m tall (Harrington, 1964)

FRUIT: An achene 3 mm long with bent and twisted style (Harrington, 1964)

#### PRETREATMENT

STRATIFICATION AND SCARIFICATION: Moist chill at 4°C for 8 days (Bowns & West, 1976)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 4°C (Bowns & West, 1976)

LIGHT: Best in light but not essential (Bowns & West, 1976)

GERMINATIVE ENERGY: 80% in 6 days (Bowns & West, 1976)

GERMINATIVE CAPACITY: 90% in 13 days (Bowns & West, 1976)

#### CULTURAL PRACTICES

PLANTING TIME: Fall (Bowns & West, 1976)

EXPOSURE: Sun (Stark, 1966)

SOIL TEXTURE: Coarse (Stark, 1966)

SOIL DEPTH: Moderate (Stark, 1966)

SOIL MOISTURE: Dry (Stark, 1966)

PRECIPITATION: 5+" (Stark, 1966)

FIELD PLANTING: Has been seeded successfully (Stark, 1966)

*COLUTEA ARBORESCENS* L.  
(Common Bladder Senna)

FAMILY: Fabaceae

LIFEFORM: Introduced ornamental shrub (Bailey, 1949)

FRUIT: An inflated pod 2-3" long (Bailey, 1949)

#### PROCUREMENT

SEEDS/LB: 21,100 (Plummer et al., 1968); 25,000-270,454 (Swingle, 1939)

SEED MATURITY: Jul 25-Oct 5 UT (Plummer et al., 1968); Fall (Swingle, 1939)

METHOD OF COLLECTION: Hand pick the pods (Plummer et al., 1968)

METHOD OF CLEANING: Chopper-macerator, fan (Plummer et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: Dry (Swingle, 1939)

DURATION OF GOOD VIABILITY: 3 years (Plummer et al., 1968)

STRATIFICATION AND SCARIFICATION: Soak in sulfuric acid for 15 minutes (Swingle, 1939)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 10% (Swingle, 1939)

*CORNUS STOLONIFERA* Michx.  
(Red-osier Dogwood)

FAMILY: Cornaceae

LIFEFORM: Native shrub to 4 m tall (Harrington, 1964)

FRUIT: A drupe 7-9 mm in diameter (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 13,800-26,700--avg 18,500 (Brinkman, 1974c); 17,260 (Plummer et al., 1968); 17,300-21,824 (Swingle, 1939); 15,500 (McKeever, 1938)

SEED MATURITY: Jul-Oct MN (Brinkman, 1974c);  
Aug 20-Sep 10 UT (Plummer et al., 1968);  
Late summer-fall (Swingle, 1939)  
METHOD OF COLLECTION: Strip or shake fruit  
from branches (Brinkman, 1974c); Hand pick  
into container (Plummer et al., 1968)  
METHOD OF CLEANING: Macerate fruit in water  
or hammermill, dry (Brinkman, 1974c);  
Dybvig with water, dry (Plummer et al.,  
1968)

#### PRETREATMENT

METHOD OF STORAGE: Store dry in sealed  
containers at 38-41°F (Brinkman, 1974a;  
Swingle, 1939)  
DURATION OF GOOD VIABILITY: 2-4 years  
(Brinkman, 1974c); 5 years (Plummer  
et al., 1968)  
STRATIFICATION AND SCARIFICATION: Moist  
chill at 35-41°F for 60-90 days (Brinkman,  
1974c); Moist chill at 41°F for 120 days  
(Babb, 1959); Moist chill at 35°F for 90  
days, scarification reduces total germina-  
tion (Peterson, 1953); Moist chill at 40-  
41°F for 113-290 days (Swingle, 1939);  
Soak in sulfuric acid for 1 hour then  
moist chill in peat (pH 3.95) at 5°C for  
8 weeks (McKeever, 1938); Moist chill for  
71-112 days (Nichols, 1934); Sow in soil  
over winter (Adams, 1927)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating at 86°F day and 68°F  
night (Brinkman, 1974c); Alternating at  
80°F day and 45°F night (Peterson, 1953)  
MOISTURE: Moist (Peterson, 1953)  
GERMINATIVE ENERGY: 35% in 13-18 days (Brink-  
man, 1974c); 84% in 34 days (Peterson,  
1953); 63% in 16 days (McKeever, 1938)  
GERMINATIVE CAPACITY: 57% in 60-90 days  
(Brinkman, 1974c); 87% in 42 days (Peter-  
son, 1953); 6-75% (Swingle, 1939); 71% in  
33 days (McKeever, 1938); 25% in 21-277  
days (Nichols, 1934); 73-76% (Adams, 1927)  
COMMENTS: Dormancy due to both seed coat and  
immature embryo (McKeever, 1938)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4-1/2" (Brinkman, 1974c)  
PLANTING TIME: Fall (Brinkman, 1974c); Fall  
or spring with stratified seed (Peterson,  
1953; Swingle, 1939)  
EXPOSURE: Sun or shade (Stark, 1966)  
SOIL TEXTURE: Medium to coarse (Sutton &  
Johnson, 1974)  
SOIL pH: 7.0-8.0 (Sutton & Johnson, 1974)  
SOIL DEPTH: Moderate (Sutton & Johnson, 1974)  
SOIL MOISTURE: Moist to wet (Sutton & Johnson,  
1974)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Good drainage, water for short  
period (Sutton & Johnson, 1974); Well-  
drained (Stark, 1966)  
GREENHOUSE PLANTING: Reproduces well by cut-  
tings (Swingle, 1939); Seedlings inhibited  
by treatment with growth substances  
(Barton, 1940)  
NURSERY PLANTING: Mulch with 1/2-1" sawdust  
(Brinkman, 1974c)

*COWANIA MEXICANA STANSBURIANA* (Torr.) Jepson  
(Mexican Cliffrose)

SYNONYMY: *Cowania mexicana*, *Cowania*  
*stansburiana*  
FAMILY: Rosaceae  
LIFEFORM: Native evergreen shrub to 3.5 m  
tall (Harrington, 1964)  
FRUIT: An achene 3 mm long with a plumose  
style 25-50 mm long (Blauer et al., 1975)

#### PROCUREMENT

SEEDS/LB: 60,800-67,000 (Alexander et al.,  
1974); 64,615 (Plummer et al., 1968)  
SEED MATURITY: Jul 15-Aug 30 (Alexander  
et al., 1974); Jul 5-Aug 10 UT (Plummer  
et al., 1968)  
METHOD OF COLLECTION: Hand pick or shake seed  
into containers (Alexander et al., 1974);  
Knock from bushes onto canvas or into  
hopper (Plummer et al., 1968)  
METHOD OF CLEANING: Dry, hammermill, or  
Dybvig, and fan (Alexander et al., 1974);  
Chopper-macerator, fan, Dybvig, dry, and  
fan (Plummer et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: Sealed containers at 36-  
41°F (Springfield, 1973a)  
DURATION OF GOOD VIABILITY: 7 years (Alex-  
ander et al., 1974); 5 years (Plummer  
et al., 1968)  
STRATIFICATION AND SCARIFICATION: Moist chill  
treatment may be helpful (Alexander et al.,  
1974); Moist chill at 3-5°C for 1 month  
(Heit, 1970)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 54-57°F (Spring-  
field, 1973a); Alternating at 30°C day and  
10°C night (Heit, 1970, 1968)  
LIGHT: Does not require light (Heit, 1968)  
GERMINATIVE CAPACITY: 89-99% in 90 days  
(Alexander et al., 1974); 95% (Springfield,  
1973a); 90% in 10 days (Heit, 1970); 21%  
(Swingle, 1939)  
COMMENTS: Staining embryos for 2 hours in an  
0.5% TTC solution at 40°C gives nearly  
optimal results in terms of rapidity and  
intensity of staining (Piatt & Springfield,  
1973)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4-1/2" (Alexander et al.,  
1974)  
PLANTING TIME: Fall or early winter (Alex-  
ander et al., 1974)  
EXPOSURE: Sun (Sutton & Johnson, 1974); Seed-  
lings survive only in shade (Woodmansee,  
1969)  
SOIL TEXTURE: Rocky to coarse (Sutton & John-  
son, 1974)  
SOIL pH: 7.0-8.0 (Stark, 1966)  
SOIL DEPTH: Deep (Sutton & Johnson, 1974)  
SOIL MOISTURE: Dry (Stark, 1966)



DRAINAGE: Well-drained (Sutton & Johnson, 1974)  
 NURSERY PLANTING: Treatment of seed with rodenticide repellent is helpful (Alexander et al., 1974)  
 FIELD PLANTING: Drill 1/2-1 lb per 8-10 lb total seed, or broadcast 1-2 lb of seed per 12-20 lb of total seed (Alexander et al., 1974); Natural germination is erratic, dependent upon adequate moisture and proper timing of precipitation (Woodmansee, 1969)

*CRATAEGUS CHRYSOCARPA* Ashe  
 (Fireberry Hawthorn)

FAMILY: Rosaceae  
 LIFEFORM: Native small tree 2-7 m tall (Harrington, 1964)  
 FRUIT: A pome 8-9 mm long with 3-4 nutlets (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 10,750 (Brinkman, 1974d)  
 SEED MATURITY: Sep (Brinkman, 1974d)  
 METHOD OF COLLECTION: Hand pick (Brinkman, 1974d)  
 METHOD OF CLEANING: Macerate in water, dry (Brinkman, 1974d)

#### PRETREATMENT

METHOD OF STORAGE: Store dry at 41°F (Brinkman, 1974d)  
 DURATION OF GOOD VIABILITY: 2-3 years (Brinkman, 1974d)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4" (Brinkman, 1974d)  
 NURSERY PLANTING: Plant in rows 8-12" apart; do not keep in seedbed more than 1 year (Brinkman, 1974d)

*CRATAEGUS SUCCULENTA* Schrad.  
 (Fleshy Hawthorn)

FAMILY: Rosaceae  
 LIFEFORM: Native tall shrub or small tree up to 7 m tall (Harrington, 1964)  
 FRUIT: A pome 7-11 mm in diameter with 2-4 nutlets (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 20,600 (Brinkman, 1974d)  
 SEED MATURITY: Sep-Oct (Brinkman, 1974d)  
 METHOD OF COLLECTION: Hand pick (Brinkman, 1974d)  
 METHOD OF CLEANING: Macerate in water, dry (Brinkman, 1974d)

#### PRETREATMENT

METHOD OF STORAGE: Store dry at 41°F (Brinkman, 1974d)  
 DURATION OF GOOD VIABILITY: 2-3 years (Brinkman, 1974d)  
 STRATIFICATION AND SCARIFICATION: Soak seeds 1/2 hour in sulfuric acid then moist chill at 40°F for 110-140 days (Brinkman, 1974d)  
 GERMINATIVE CAPACITY: 35-40% (Brinkman, 1974d)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4" (Brinkman, 1974d)  
 NURSERY PLANTING: Plant in rows 8-12" apart; do not keep in seedbed more than 1 year (Brinkman, 1974d)

*ELAEAGNUS ANGUSTIFOLIA* L.  
 (Russian Olive)

FAMILY: Elaeagnaceae  
 LIFEFORM: Introduced shrub or tree to 7 m tall (Harrington, 1964)  
 FRUIT: An achene 1 cm long (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 2,900-5,160 (USDA Forest Service, 1976); 3,470-6,940--avg 5,160 (Olson, 1974a); 2,870 (Plummer et al., 1968); 1,846-4,828 (Swingle, 1939); 2,780 (McKeever, 1938)  
 SEED MATURITY: Aug-Oct (USDA Forest Service, 1976; Olson, 1974a); Aug 25-Jan 15 UT (Plummer et al., 1968); Fall (Swingle, 1939)  
 METHOD OF COLLECTION: Hand pick or strip onto canvas (USDA Forest Service, 1976; Olson, 1974a); Knock from trees onto canvas (Plummer et al., 1968)  
 METHOD OF CLEANING: Macerate with water and float or screen (Olson, 1974a); Dybvig with water and dry (Plummer et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: In sealed containers with 6-14% moisture at 33-40°F (USDA Forest Service, 1976); Dry in sealed containers at 34-50°F (Olson, 1974a); Dry (Swingle, 1939)  
 DURATION OF GOOD VIABILITY: Up to 3 years (USDA Forest Service, 1976; Olson, 1974a); 10 years (Plummer et al., 1968); 5 1/2 years (King, 1947)  
 STRATIFICATION AND SCARIFICATION: Soak seed for 1/2-1 hour in sulfuric acid then moist chill at 34-50°F for 60-90 days (USDA Forest Service, 1976; Olson, 1974a); Soak seed for 1/2-1 hour in sulfuric acid then moist chill at 3-5°C for 21-28 days (Heit, 1968); Moist chill at 40°F for 3 months (Stark, 1966); Moist chill at 34-50°F for 60-90 days (Hervey & Boyd, 1953; Swingle, 1939); After ripen in dry storage for

14 weeks then moist chill at 5°C for 14 weeks (King, 1947); Moist chill at 5°C in peat (pH 3.95) for 6 weeks (McKeever, 1938)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating at 86°F day and 68°F night (Olson, 1974a); Constant at 20-30°C (Heit, 1968)

LIGHT: Best germination in light (Heit, 1968)  
GERMINATIVE ENERGY: 7-76% in 10-32 days (Olson, 1974a); 44% in 18 days (King, 1947)

GERMINATIVE CAPACITY: 7-90% (USDA Forest Service, 1976); 7-79% in 60 days (Olson, 1974a; Swingle, 1939); 44% in 38 days (King, 1947); 86% in 11 days (McKeever, 1938)

COMMENTS: Dormancy due to both the seed coat and an immature embryo (McKeever, 1938)

#### CULTURAL PRACTICES

PLANTING DEPTH: Broadcast or drill 1/2" (USDA Forest Service, 1976); 1/2-1" (Olson, 1974a)

PLANTING TIME: Stratified seed in spring (Hartman & Kester, 1975); Late summer or fall (Olson, 1974a)

EXPOSURE: Sun (Stark, 1966)

SOIL TEXTURE: Variable (Stark, 1966)

SOIL pH: Will tolerate alkali (Stark, 1966)

SOIL SALINITY: Tolerates 10,000 ppm NaCl and CaCl<sub>2</sub> (Stark, 1966)

SOIL MOISTURE: Dry (Stark, 1966)

DRAINAGE: Well-drained (Stark, 1966)

GREENHOUSE PLANTING: Reproduces well by cuttings (Swingle, 1939)

NURSERY PLANTING: Start in sand or peat; mulch fall sown seed (USDA Forest Service, 1976); Use cleaned seed to discourage rodents; mulch and avoid soil splash; seed 12-30 seeds per square foot (Olson, 1974a)

*ELAEAGNUS COMMUTATA* Bernh.  
(Silverberry)

FAMILY: Elaeagnaceae

LIFEFORM: Native shrub or small tree 2-5 m tall (Harrington, 1964)

FRUIT: An achene (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 2,700-4,600--avg 3,800 (Olson, 1974a); 3,635-3,800 (Swingle, 1939)

SEED MATURITY: Aug-Sep (Olson, 1974a); Sep (Swingle, 1939)

METHOD OF COLLECTION: Hand pick or strip onto canvas (Olson, 1974a)

METHOD OF CLEANING: Macerate with water and float or screen (Olson, 1974a)

#### PRETREATMENT

METHOD OF STORAGE: Store dry in sealed containers at 34-50°F (Olson, 1974a)

DURATION OF GOOD VIABILITY: 1-2 years (Olson, 1974a)

STRATIFICATION AND SCARIFICATION: Moist chill at 34-50°F for 60-90 days (Olson, 1974a); Moist chill at 40°F for 90 days (Babb, 1959)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating at 86°F (Olson, 1974a)

GERMINATIVE ENERGY: 52% in 13 days (Olson, 1974a)

GERMINATIVE CAPACITY: 90% (Hartman & Kester, 1975); 60% in 50 days (Olson, 1974a)

COMMENTS: There may be a germination inhibitor in the pit (Hartman & Kester, 1975)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/2-1" (Olson, 1974a)

PLANTING TIME: Late summer or fall (Olson, 1974a)

GREENHOUSE PLANTING: Reproduces well from cuttings (Swingle, 1939)

NURSERY PLANTING: Use cleaned seed to discourage rodents, mulch, avoid soil splash, plant 12-30 seeds per square foot (Olson, 1974a)

*EPHEDRA TORREYANA* Wats  
(Torrey Ephedra)

FAMILY: Ephedraceae

LIFEFORM: Native shrub 25-100 cm tall (Harrington, 1964)

FRUIT: Nutlike (Stark, 1966)

#### CULTURAL PRACTICES

PLANTING TIME: Spring (Stark, 1966)

EXPOSURE: Sun (Stark, 1966)

SOIL TEXTURE: On limestone and gypsum soils (Stark, 1966)

SOIL MOISTURE: Dry (Stark, 1966; Harrington, 1964)

*EPHEDRA VIRIDIS* Coville  
(Green Ephedra)

FAMILY: Ephedraceae

LIFEFORM: Native evergreen shrub 50-100 cm tall (Harrington, 1964)

FRUIT: Nutlike (Stark, 1966)

#### PROCUREMENT

SEEDS/LB: 25,200 (Kay et al., 1977e); 18,000 (Williams et al., 1974); 24,955 (Plummer et al., 1968)

SEED MATURITY: Jul 15-Sep 1 UT (Plummer et al., 1968)

METHOD OF COLLECTION: Knock seed from bush into hopper (Plummer et al., 1968)  
METHOD OF CLEANING: Dry, fan, Crippen EP-26, fan (Plummer et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: Store dry at 70°F (Young et al., 1977)  
DURATION OF GOOD VIABILITY: 5 years (Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Germination may be increased by a period of after-ripening (Kay et al., 1977c)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating at 15-25°C day and 2-5 °C night (Young et al., 1977)  
MOISTURE: Best at 0 bars tension; will germinate with tension as low as 8 bars (Young et al., 1977)  
GERMINATIVE ENERGY: 58% in 12 days (Young et al., 1977)  
GERMINATIVE CAPACITY: 77-87% in 30 days (Young et al., 1977); 56% in 5 days (Williams et al., 1974)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1-2 cm (Kay et al., 1977e; Williams et al., 1974)  
PLANTING TIME: Spring (Stark, 1966)  
EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Medium to coarse, on limestone cliffs (Stark, 1966)  
SOIL pH: Slight saline-alkaline tolerance (Stark, 1966)  
SOIL DEPTH: Medium to shallow (Stark, 1966)  
SOIL MOISTURE: Dry (Stark, 1966)  
PRECIPITATION: 6-10" (Stark, 1966)  
FIELD PLANTING: Seeds well (Stark, 1966)

*FALLUGIA PARADOXA* (Don) Endl.  
(Common Apacheplume)

FAMILY: Rosaceae  
LIFEFORM: Native shrub 50-150 cm tall (Harrington, 1964)  
FRUIT: An achene 3 mm long with plumose style 25-38 mm long (Blauer et al., 1975)

#### PROCUREMENT

SEEDS/LB: 420,000 (Blauer et al., 1975; Swingle, 1939; Mirov & Kraebel, 1937); 500,000-580,000--avg 54,000 (Deitschman et al., 1974c)  
SEED MATURITY: Aug-Nov NV (Stark, 1966); Jun-Jul CA (Swingle, 1939; Mirov & Kraebel, 1937)  
METHOD OF COLLECTION: Strip fruits or shake onto canvas (Deitschman et al., 1974c)

#### PRETREATMENT

METHOD OF STORAGE: Store dry seed in cloth or burlap bag in ventilated warehouse (Deitschman et al., 1974c; Swingle, 1939)  
DURATION OF GOOD VIABILITY: 2-3 years (Deitschman et al., 1974c)  
STRATIFICATION AND SCARIFICATION: Moist chill treatments may be beneficial (Swingle, 1939)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 32-38°F (Deitschman et al., 1974c)  
GERMINATIVE ENERGY: 42% in 14 days (Deitschman et al., 1974c); 42% in 7 days (Mirov & Kraebel, 1937)  
GERMINATIVE CAPACITY: 60-73% in 60 days (Deitschman et al., 1974c); 42-62% (Swingle, 1939)

#### CULTURAL PRACTICES

PLANTING TIME: Fall or spring (Deitschman et al., 1974c); Spring (Swingle, 1939)  
EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Rocky, sandy, and limestone washes (Stark, 1966)  
SOIL DEPTH: Moderate to deep (Blauer et al., 1975)  
SOIL MOISTURE: Dry (Stark, 1966)  
DRAINAGE: Well drained (Stark, 1966)  
NURSERY PLANTING: Broadcast seed and cover with 1/16" soil and 1/8-1/4" sand on firm seedbed (Deitschman et al., 1974c)  
FIELD PLANTING: Has considerable ecotypic variation (Mirov & Kraebel, 1937)

*FORESTIERA NEOMEXICANA* Gray  
(Desert Olive)

FAMILY: Oleaceae  
LIFEFORM: Native shrub 1-3.5 m tall (Harrington, 1964)  
FRUIT: A drupe 6-8 mm long (Harrington, 1964)

#### PROCUREMENT

SEED MATURITY: Summer (Swingle, 1939)

#### PRETREATMENT

METHOD OF STORAGE: Dry (Swingle, 1939)  
STRATIFICATION AND SCARIFICATION: Moist chill for 30 days (Swingle, 1939)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 55-72% (Swingle, 1939)

#### CULUTRAL PRACTICES

PLANTING TIME: Fall or spring with stratified seed (Swingle, 1939)  
EXPOSURE: Sun or partial shade (Stark, 1966)  
SOIL TEXTURE: Medium to fine (Stark, 1966)



SOIL DEPTH: Moderate (Stark, 1966)  
SOIL MOISTURE: Dry (Stark, 1966)  
DRAINAGE: Well drained (Stark, 1966)  
GREENHOUSE PLANTING: Reproduces well from cuttings (Swingle, 1939)

*FRAXINUS ANOMALA* Torr. ex S. Wats  
(Singleleaf Ash)

FAMILY: Oleaceae  
LIFEFORM: Native shrub or small tree 2-8 m tall (Harrington, 1964)  
FRUIT: A samara 12-25 mm long (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 20,350 (Plummer et al., 1968); 22,050 (Swingle, 1939)  
SEED MATURITY: Jul 15-Sep 10 UT (Plummer et al., 1968)  
METHOD OF COLLECTION: Hand strip into container (Plummer et al., 1968)  
METHOD OF CLEANING: Hammermill and fan (Plummer et al., 1968)

#### PRETREATMENT

DURATION OF GOOD VIABILITY: 2-3 years (Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Moist chill at 4°C for 2-4 months (Hartmann & Kester, 1975)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 0% (Hartmann & Kester, 1975)

#### CULTURAL PRACTICES

EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Prefers limestone (Stark, 1966)  
DRAINAGE: Well drained (Stark, 1966)

*GRAYIA BRANDEGEI* A. Gray  
(Spineless Hopsage)

FAMILY: Chenopodiaceae  
LIFEFORM: Native shrub 20-70 cm (Harrington, 1964)  
FRUIT: A 1-seeded utricle with bracts 5-6 mm long (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 190,000 (Smith, 1974a); 189,950 (Plummer et al., 1968)  
SEED MATURITY: Jun-Jul (Smith, 1974a); Sep 11-Dec 15 UT (Plummer et al., 1968)  
METHOD OF COLLECTION: Strip seeds into container (Smith, 1974a)  
METHOD OF CLEANING: Hammermill and fan (Smith, 1974a); Pick out sticks and stems (Plummer et al., 1968)

#### PRETREATMENT

DURATION OF GOOD VIABILITY: 2 years (Plummer et al., 1968)

#### CULTURAL PRACTICES

SOIL TEXTURE: Fine to medium (Blauer et al., 1976)  
SOIL pH: 7.4-7.7 (Blauer et al., 1976); tolerates alkali (Smith, 1974a)

*GRAYIA SPINOSA* (Hook.) Moq.  
(Spiny Hopsage)

FAMILY: Chenopodiaceae  
LIFEFORM: Native shrub 30-100 cm tall (Harrington, 1964)  
FRUIT: A utricle with winged bracts 5-12 mm long (Wood et al., 1976)

#### PROCUREMENT

SEEDS/LB: Fruits are 153,600-168,000, seeds are 395,200-424,000 (Smith, 1974a); 166,765 (Plummer et al., 1968); 395,200 (Glazebrook, 1941); 153,600 (Swingle, 1939)  
SEED MATURITY: Jun-Jul (Smith, 1974a); Jul 1-Aug 10 UT (Plummer et al., 1968); Jul-Aug NV (Stark, 1966); Summer (Swingle, 1939)  
METHOD OF COLLECTION: Strip seeds into container (Smith, 1974a); Knock seed from bushes into hopper or onto canvas (Plummer et al., 1968)  
METHOD OF CLEANING: Hammermill and fan (Smith, 1974a); Pick out sticks and stems and fan (Plummer et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: Store in a cool, dry place (Smith, 1974a)  
DURATION OF GOOD VIABILITY: 6 years (Smith, 1974a; King, 1947); 2 years (Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Moist chill at 38°F for 60-90 days (Smith, 1974a); Stratification requirement decreases with the age of seed, 6-years-old (2 weeks) and 4-years-old (2-12 weeks) (King, 1947)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 10-15°C or alternating at 10-30°C day and 5°C night (Wood et al., 1976); Alternating at 86°F day and 68°F night (Smith, 1974a); Alternating at 30°C day and 20°C night (Glazebrook, 1941)  
MOISTURE: Best at 0 bars tension, will germinate with as low as 12-16 bars tension (Wood et al., 1976)  
LIGHT: Neither light nor dark sensitive (Glazebrook, 1941)  
GERMINATIVE ENERGY: 85-90% in 14 days (Wood et al., 1976); 6% (Housley, 1952); 25% in 10 days (King, 1947)

GERMINATIVE CAPACITY: 88% in 35 days (Smith, 1974a); Complete in 55 days (Housley, 1952); 51% (King, 1947); 92% in 35 days (Glazebrook, 1941)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1 cm (Kay et al., 1977d); 0.5 cm (Wood et al., 1976); On surface (Glazebrook, 1941)  
PLANTING TIME: Mar (Stark, 1966); Early fall or late spring (Glazebrook, 1941)  
EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Variable (Stark, 1966)  
SOIL pH: Tolerates alkali (Smith, 1974a); High alkali tolerance, slight saline-alkali tolerance (Stark, 1966)  
SOIL DEPTH: 36-60" (Stark, 1966)  
PRECIPITATION: 6-14+" (Stark, 1966)  
DRAINAGE: Well drained (Stark, 1966)

*GUTIERREZIA SAROTHRAE* (Pursh) Britt. & Rusby  
(Broom Snakewood)

FAMILY: Asteraceae  
LIFEFORM: Native half shrub 10-70 cm tall (Harrington, 1964)  
FRUIT: An achene (Harrington, 1964)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 60-70°F (Kruse, 1970)  
MOISTURE: Moist, will germinate with a tension as low as 6 atmospheres (Kruse, 1970)  
GERMINATIVE CAPACITY: 95% (Kruse, 1970)

#### CULTURAL PRACTICES

PLANTING TIME: Spring (Stark, 1966)  
EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Medium to coarse (Stark, 1966)  
SOIL SALINITY: Moderate salt tolerance (Stark, 1966)  
SOIL MOISTURE: Dry (Stark, 1966)  
PRECIPITATION: 3-5" (Stark, 1966)  
DRAINAGE: Well drained (Stark, 1966)

*HOLODISCUS DUMOSUS* (Nutt.) Heller  
(Rock Spiraea)

FAMILY: Rosaceae  
LIFEFORM: Native shrub 50-300 cm tall (Harrington, 1964)  
FRUIT: An achene (Harrington, 1964)

#### PRETREATMENT

STRATIFICATION AND SCARIFICATION: Moist chill at 5°C for 18 weeks (King, 1947)

#### LABORATORY GERMINATION

MOISTURE: Near saturation (King, 1947)  
COMMENTS: Sound seed can be determined by observing embryos wet with a 15x scope with black light (King, 1947)

#### CULTURAL PRACTICES

PLANTING TIME: Fall (Stark, 1966)  
SOIL TEXTURE: Medium to coarse (Stark, 1966)  
SOIL pH: Found on limestone cliffs (Stark, 1966)  
SOIL DEPTH: Shallow (Stark, 1966)  
SOIL MOISTURE: Dry (Stark, 1966)  
DRAINAGE: Well drained (Stark, 1966)  
NURSERY PLANTING: Easily grown from seed (Stark, 1966)

*JUNIPERUS COMMUNIS* L.  
(Common Juniper)

FAMILY: Cupressaceae  
LIFEFORM: Native shrub to 100 cm tall (Harrington, 1964)  
FRUIT: Berry-like, 1-4 seeded (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 25,450-54,500--avg 36,500 (Johnson & Alexander, 1974); 24,454-32,500 (Swingle, 1939)  
SEED MATURITY: Aug-Oct (Johnson & Alexander, 1974); Fall (Swingle, 1939)  
METHOD OF COLLECTION: Strip or pick into container or shake onto canvas (Johnson & Alexander, 1974)  
METHOD OF CLEANING: Fan, Dybvig with water, dry and fan (Johnson & Alexander, 1974)

#### PRETREATMENT

STRATIFICATION AND SCARIFICATION: Warm stratify at 86°F day and 68°F night for 45-90 days then moist chill to induce germination for 90+ days (Johnson & Alexander, 1974)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating at 86°F day and 68°F night (Johnson et al., 1974)  
GERMINATIVE CAPACITY: 7-75% in 20-30 days (Johnson & Alexander, 1974)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4" (Johnson et al., 1974)  
PLANTING TIME: Late summer or fall (Johnson & Alexander, 1974); Spring (Stark, 1966)  
EXPOSURE: Sun or shade (Sutton & Johnson, 1974)  
SOIL TEXTURE: Fine to coarse (Stark, 1966)  
SOIL pH: 7.0 (Sutton & Johnson, 1974)  
SOIL DEPTH: Deep (Sutton & Johnson, 1974)  
SOIL MOISTURE: Dry to moist (Sutton & Johnson, 1974)  
ORGANIC MATTER: If possible (Sutton & Johnson, 1974)  
DRAINAGE: Well drained (Sutton & Johnson, 1974)  
GREENHOUSE PLANTING: Reproduces well by cuttings (Swingle, 1939)  
NURSERY PLANTING: Mulch, have moist seedbed, remove mulch on germination, give light shade (Johnson & Alexander, 1974)



*KOCHIA AMERICANA* S. Wats  
(Desert Molly)

FAMILY: Chenopodiaceae  
LIFEFORM: Native half shrub 10-40 cm tall  
(Harrington, 1964)  
FRUIT: 1-seeded utricle with wings 1.5-2 mm  
long (Harrington, 1964)

PRETREATMENT

METHOD OF STORAGE: Store dry at 70°F (Clarke &  
West, 1969)  
STRATIFICATION AND SCARIFICATION: Mechanical  
scarification promotes germination (Clarke  
& West, 1969)

LABORATORY GERMINATION

TEMPERATURE: Alternating at 86°F day and 68°F  
night (Clarke & West, 1969)  
COMMENTS: Salinity tolerance during germina-  
tion is very high up to 10% NaCl solution  
but tolerance may vary with seed source  
(Clarke & West, 1969)

CULTURAL PRACTICES

SOIL pH: Saline-alkaline tolerant (Clarke &  
West, 1969)

*LEPTODACTYLON PUNGENS* (Torr.) Rydb.  
(Prickly Phlox)

FAMILY: Polemoniaceae  
LIFEFORM: Native half shrub 10-20 cm tall  
(Harrington, 1964)  
FRUIT: A capsule (Stark, 1966)

CULTURAL PRACTICES

EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Medium to coarse (Stark, 1966)  
SOIL pH: Found on limestone (Stark, 1966)  
SOIL DEPTH: Moderate (Stark, 1966)

*LONICERA INVOLUCRATA* (Rich.) Banks  
(Black Twinberry)

FAMILY: Caprifoliaceae  
LIFEFORM: Native shrub 50-300 cm tall  
(Harrington, 1964)  
FRUIT: Berry-like and few seeded 8 mm in  
diameter (Harrington, 1964)

PROCUREMENT

SEEDS/LB: 227,000-477,000--avg 326,500  
(Brinkman, 1974e); 226,800-476,800  
(Swingle, 1939)  
SEED MATURITY: Jul-Aug Northern Rockies  
(Brinkman, 1974e); Late summer to fall UT

(Sutton & Johnson, 1974); Aug-Sep NV  
(Stark, 1966); Early summer (Swingle,  
1939)

METHOD OF COLLECTION: Hand pick or strip  
into container (Brinkman, 1974e)  
METHOD OF CLEANING: Macerate in water, dry  
(Brinkman, 1974e)

PRETREATMENT

METHOD OF STORAGE: Store dry in sealed con-  
tainers at 34-38°F (Brinkman, 1974e)  
STRATIFICATION AND SCARIFICATION: Moist  
chill (Brinkman, 1974e)

LABORATORY GERMINATION

TEMPERATURE: Constant at 18°C (Heit, 1968)  
GERMINATIVE CAPACITY: 83% (Brinkman, 1974e;  
Swingle, 1939)

CULTURAL PRACTICES

PLANTING DEPTH: 1/8-1/4" (Brinkman, 1974e)  
PLANTING TIME: Fall (Brinkman, 1974e)  
EXPOSURE: Shade (Sutton & Johnson, 1974)  
SOIL TEXTURE: Medium (Sutton & Johnson, 1974)  
SOIL pH: 7.0 (Sutton & Johnson, 1974)  
SOIL DEPTH: Moderate to shallow (Sutton &  
Johnson, 1974)  
SOIL MOISTURE: Moist (Stark, 1966)  
ORGANIC MATTER: If possible (Sutton & Johnson,  
1974)  
DRAINAGE: Well drained (Sutton & Johnson,  
1974)  
NURSERY PLANTING: Mulch with 2-3" straw  
(Brinkman, 1974e)

*LYCIUM HALIMIFOLIUM* Mill.  
(Matrimony Vine)

SYNONYMY: *Lycium barbarum*  
FAMILY: Solanaceae  
LIFEFORM: Introduced shrub 1-6 m tall  
(Harrington, 1964)  
FRUIT: Fleshy berry 1 cm long (Harrington,  
1964)

PROCUREMENT

SEEDS/LB: 266,100 (Glazebrook, 1941); 260,000  
(Swingle, 1939)  
SEED MATURITY: Fall (Swingle, 1939)

PRETREATMENT

METHOD OF STORAGE: Dry (Swingle, 1939)  
STRATIFICATION AND SCARIFICATION: Moist chill  
at 5°C for 2-4 weeks (Glazebrook, 1941)

LABORATORY GERMINATION

GERMINATIVE ENERGY: 63% in 10 days (Glaze-  
brook, 1941)  
GERMINATIVE CAPACITY: 71-73% in 20-30 days  
(Glazebrook, 1941)

## CULTURAL PRACTICES

PLANTING TIME: Spring (Swingle, 1939)  
GREENHOUSE PLANTING: Reproduces well by cuttings (Swingle, 1939)

*MAHONIA FREMONTII* (Torr.) Fedde  
(Fremont Barberry)

SYNONYMY: *Berberis fremontii*  
FAMILY: Berberidaceae  
LIFEFORM: Native shrub 1-3 m tall (Harrington, 1964)  
FRUIT: A berry 6-14 mm in diameter (Harrington, 1964)

## PROCUREMENT

SEEDS/LB: 42,000 (Rudolf, 1974a); 41,770 (Plummer et al., 1968)  
SEED MATURITY: Jul-Aug UT (Rudolf, 1974a);  
Jul 15-Aug 20 UT (Plummer et al., 1968)  
METHOD OF COLLECTION: Hand pick or flail into receptacles or cloth on the ground (Rudolf, 1974a); Hand strip into hoppers (Plummer et al., 1968)  
METHOD OF CLEANING: Macerate with water then screen or float, dry (Rudolf, 1974a);  
Dybvig with water, dry and fan (Plummer et al., 1968)

## PRETREATMENT

METHOD OF STORAGE: Sealed containers slightly above freezing (Rudolf, 1974a)  
DURATION OF GOOD VIABILITY: 5 years (Rudolf, 1974a; Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Moist chill at 40°F for 2-6 weeks (Stark, 1966); None necessary (Swingle, 1939)

## LABORATORY GERMINATION

GERMINATIVE CAPACITY: 85% (Rudolf, 1974a);  
81% (Swingle, 1939)

## CULTURAL PRACTICES

PLANTING TIME: Fall (Rudolf, 1974a)  
EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Rocky (Stark, 1966)  
SOIL MOISTURE: Dry (Stark, 1966)  
DRAINAGE: Well drained (Stark, 1966)  
NURSERY PLANTING: Cover seed with 1/8-1/2" soil and 1/4" sand (Rudolf, 1974a)  
FIELD PLANTING: Mulch improves germination, mold may attack seeds planted with berries, under natural conditions seeds germinate the spring following dispersal (Rudolf, 1974a)

*MAHONIA REPENS* (Lindl.) G. Don  
(Creeping Barberry)

SYNONYMY: *Berberis repens*  
FAMILY: Berberidaceae  
LIFEFORM: Native shrub less than 25 cm tall (Harrington, 1964)  
FRUIT: A berry 7-8 mm long (Harrington, 1964)

## PROCUREMENT

SEEDS/LB: 54,000-71,000--avg 62,000 (Rudolf, 1974a); 71,120 (Plummer et al., 1968)  
SEED MATURITY: Jun-Sep SD (Rudolf, 1974a);  
Aug 5-Sep 10 UT (Plummer et al., 1968)  
METHOD OF COLLECTION: Hand pick or flail onto receptacles or cloth on the ground (Rudolf, 1974a); Hand strip into hoppers (Plummer et al., 1968)  
METHOD OF CLEANING: Macerate with water then screen or float, dry (Rudolf, 1974a);  
Dybvig with water, dry and fan (Plummer et al., 1968)

## PRETREATMENT

METHOD OF STORAGE: Sealed containers slightly above freezing (Rudolf, 1974a)  
DURATION OF GOOD VIABILITY: 5 years (Rudolf, 1974a; Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Successive cold, warm, and cold stratification periods aid germination (Rudolf, 1974a);  
Moist chill at 2°C for 16 weeks in an 0.001 molar solution of gibberellic acid (McDonough, 1969); Moist chill at 1°C for 30 days then warm at 20°C for 60 days then moistchill at 1°C for 196 days, scarification not necessary (McLean, 1967)

## LABORATORY GERMINATION

TEMPERATURE: Constant at 34°F or 70°F (Rudolf, 1974a); Constant at 2°C (McDonough, 1969)  
MOISTURE: Wet (Rudolf, 1974a)  
GERMINATIVE ENERGY: 62% in 150 days at 34°F (Rudolf, 1974a)  
GERMINATIVE CAPACITY: 74% in 196 days at 34°F or 10 days at 70°F (Rudolf, 1974a); 79% in 28 days (McDonough, 1969); 74% (McLean, 1967)

## CULTURAL PRACTICES

PLANTING TIME: Fall (Rudolf, 1974a)  
EXPOSURE: Sun, partial shade, or shade (Sutton & Johnson, 1974)  
SOIL TEXTURE: Coarse to medium, loam (Stark, 1966)  
SOIL pH: 5.5-7.0 (Sutton & Johnson, 1974)  
SOIL DEPTH: Shallow to moderate (Sutton & Johnson, 1974)  
SOIL MOISTURE: Dry to moist (Sutton & Johnson, 1974)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Well drained (Sutton & Johnson, 1974)  
NURSERY PLANTING: Cover with 1/8-1/2" soil and 1/4" sand (Rudolf, 1974a)

FIELD PLANTING: Mulch improves germination, mold may attack seed planted with berries, under natural conditions seeds germinate the spring following dispersal (Rudolf, 1974a)

*MENODORA SCABRA* A. Gray  
(Rough Menodora)

FAMILY: Oleaceae  
LIFEFORM: Native half shrub 7-35 cm tall (Harrington, 1964)  
FRUIT: A capsule 5-7 mm long and 7-12 mm wide (Harrington, 1964)

PROCUREMENT

SEEDS/LB: 102,000-112,000 (Krugman, 1974); 102,500 (Swingle, 1939)  
SEED MATURITY: Sep-Nov (Krugman, 1974); Early summer (Swingle, 1939)

PRETREATMENT

METHOD OF STORAGE: Store dry at 70°F (Krugman, 1974; Swingle, 1939)  
STRATIFICATION AND SCARIFICATION: Does not need stratification (Stark, 1966; Swingle, 1939)

LABORATORY GERMINATION

GERMINATIVE CAPACITY: 70-99% (Krugman, 1974; Swingle, 1939)  
COMMENTS: Seeds germinate freely (Stark, 1966)

CULTURAL PRACTICES

PLANTING TIME: Spring (Stark, 1966); Spring or summer (Swingle, 1939)  
EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Medium to coarse (Stark, 1966)  
SOIL DEPTH: Moderate to shallow (Stark, 1966)  
SOIL MOISTURE: Dry (Stark, 1966)

*OPUNTIA FRAGILIS* (Nutt.) Haw.  
(Brittle Pricklypear Cactus)

FAMILY: Cactaceae  
LIFEFORM: Native succulent shrub, joints 1.5-4 cm long (Harrington, 1964)  
FRUIT: Berry-like, dry and spiny, seed 5-7 mm long (Harrington, 1964)

CULTURAL PRACTICES

PLANTING TIME: Summer (Stark, 1966)  
EXPOSURE: Shade or semi-shade (Stark, 1966)  
SOIL TEXTURE: Medium to fine (Stark, 1966)  
SOIL DEPTH: Moderate to deep (Stark, 1966)  
SOIL MOISTURE: Dry (Harrington, 1964)

*PARTHENOCISSUS INSERTA* (Kern.) K. Fritsch.  
(Thicket Creeper)

FAMILY: Vitaceae  
LIFEFORM: Native woody vine (Harrington, 1964)  
FRUIT: A berry 5-7 mm in diameter (Harrington, 1964)

PROCUREMENT

SEEDS/LB: 14,100-23,300--avg 18,800 (Gill & Pogge, 1974a)  
SEED MATURITY: Jul-Aug (Gill & Pogge, 1974a)  
METHOD OF COLLECTION: Hand strip into container (Gill & Pogge, 1974a)  
METHOD OF CLEANING: Fan, hammermill with water, and dry (Gill & Pogge, 1974a)

PRETREATMENT

METHOD OF STORAGE: Store dry in sealed containers at 41°F (Gill & Pogge, 1974a)  
DURATION OF GOOD VIABILITY: 2 years (Gill & Pogge, 1974a)  
STRATIFICATION AND SCARIFICATION: Moist chill at 41°F for 60 days (Gill & Pogge, 1974a); Moist chill at 40°F for 2 months (Stark, 1966)

LABORATORY GERMINATION

GERMINATIVE ENERGY: Most intensive germination in 15 days (Gill & Pogge, 1974a)  
GERMINATIVE CAPACITY: 70-80% in 30 days (Gill & Pogge, 1974a)

CULTURAL PRACTICES

PLANTING DEPTH: 3/8" (Gill & Pogge, 1974a)  
PLANTING TIME: Fall or with stratified seed in spring (Gill & Pogge, 1974a); Spring (Stark, 1966)  
EXPOSURE: Sun or shade (Stark, 1966)  
SOIL TEXTURE: Variable (Stark, 1966)  
SOIL MOISTURE: Moist (Stark, 1966)  
DRAINAGE: Well drained (Stark, 1966)  
NURSERY PLANTING: 10 plants per square foot (Gill & Pogge, 1974a)

*PARTHENOCISSUS VITACEA* (Knerr) Hitchc.  
(Virginia Creeper)

SYNONYMY: *Parthenocissus quinquefolia*  
FAMILY: Vitaceae  
LIFEFORM: Native woody vine (Harrington, 1964)  
FRUIT: A berry 5-7 mm in diameter (Harrington, 1964)

PROCUREMENT

SEEDS/LB: 12,000-19,900 (Swingle, 1939)  
SEED MATURITY: Sep-Oct, fall (Adams, 1927)



#### PRETREATMENT

METHOD OF STORAGE: Dry (Swingle, 1939)  
STRATIFICATION AND SCARIFICATION: Benefits from a moist chill treatment (Swingle, 1939); Sow in soil outdoors over winter (Adams, 1927)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 99% (Swingle, 1939); 41-45% in 242-595 days (Adams, 1927)

#### CULTURAL PRACTICES

PLANTING TIME: Fall or spring (Swingle, 1939); Fall (Adams, 1927)  
GREENHOUSE PLANTING: Reproduces well from cuttings (Swingle, 1939)

*PERAPHYLLUM RAMOSISSIMUM* Nutt.  
(Squawapple)

FAMILY: Rosaceae  
LIFEFORM: Native shrub to 2 m tall (Harrington, 1964)  
FRUIT: A fleshy pome 10-15 mm in diameter with 4 seeds (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 25,900-44,600 (Smith, 1974b); 23,750 (Plummer et al., 1968)  
SEED MATURITY: Late Jun-Jul (Smith, 1974b); Jul 5-Aug 20 UT (Plummer et al., 1968)  
METHOD OF COLLECTION: Hand pick into containers (Smith, 1974b); Strip or knock fruit into hopper or onto canvas (Plummer et al., 1968)  
METHOD OF CLEANING: Mash fruit in water, dry and fan (Smith, 1974b); Dybvig with water, dry and fan (Plummer et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: Store dry in cool ventilated metal container (Smith, 1974b)  
DURATION OF GOOD VIABILITY: 5 years (Smith, 1974b; Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Moist chill in plastic bags at 38°F for 45 days (Smith, 1974b)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating at 87°F day and 68°F night (Smith, 1974b)  
GERMINATIVE ENERGY: 96% in 180 days (Monsen & Christensen, 1975)  
GERMINATIVE CAPACITY: 96% in 180 days (Monsen & Christensen, 1975); 9-51% in 30-90+ days (Smith, 1974b)

#### CULTURAL PRACTICES

PLANTING TIME: Fall (Monsen & Christensen, 1975)

EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Medium (Stark, 1966)  
SOIL pH: Near acid soils (Stark, 1966)  
SOIL DEPTH: 10-60+" (Stark, 1966)  
SOIL MOISTURE: Dry (Smith, 1974b); Dry to moist (Stark, 1966)  
PRECIPITATION: 8-14" (Stark, 1966)  
DRAINAGE: Well drained (Smith, 1966)  
NURSERY PLANTING: Rarely does well in cultivation (Stark, 1966)

*PHILADELPHUS MICROPHYLLUS* Gray  
(Littleleaf Mockorange)

FAMILY: Hydrangeaceae  
LIFEFORM: Native shrub 80-200 cm tall (Harrington, 1964)  
FRUIT: A capsule, seeds numerous (Harrington, 1964)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 69% (Swingle, 1939)

*PHYSOCARPUS ALTERNANS* (Jones) J. T. Howell  
(Dwarf Ninebark)

FAMILY: Rosaceae  
LIFEFORM: Native shrub up to 1 m tall (Harrington, 1964)  
FRUIT: A capsule (Harrington, 1964)

#### CULTURAL PRACTICES

PLANTING TIME: Spring (Stark, 1966)  
EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Coarse (Stark, 1966)  
SOIL DEPTH: Shallow (Stark, 1966)  
SOIL MOISTURE: Dry (Stark, 1966)

*PHYSOCARPUS MALVACEUS* (Greene) Kuntze  
(Mallow Ninebark)

FAMILY: Rosaceae  
LIFEFORM: Native shrub 0.5-2 m tall (Hitchcock & Cronquist, 1973)  
FRUIT: A capsule with 2-4 seeds (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 756,000 (Gill & Pogge, 1974b)  
SEED MATURITY: Aug ID, Aug 20-Sep 25 MT (Gill & Pogge, 1974b); Fall, winter UT (Sutton & Johnson, 1974)  
METHOD OF COLLECTION: Hand pick or strip onto drop cloth (Gill & Pogge, 1974b)  
METHOD OF CLEANING: Dry, thresh and clean (Gill & Pogge, 1974b)

#### PRETREATMENT

METHOD OF STORAGE: Store dry at room temperature (Gill & Pogge, 1974b)  
STRATIFICATION AND SCARIFICATION: Moist chill at 40-43°F for 77 days (Gill & Pogge, 1974b)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 80°F (Gill & Pogge, 1974b)  
GERMINATIVE ENERGY: 14% in 3 days (Gill & Pogge, 1974b)  
GERMINATIVE CAPACITY: 17% in 30 days (Gill & Pogge, 1974b)  
COMMENTS: Germinative capacity low due to large percentage of unsound seed (Gill & Pogge, 1974b)

*PHYSOCARPUS OPULIFOLIUS* (L.) Maxim  
(Common Ninebark)

FAMILY: Rosaceae  
LIFEFORM: Native shrub 3-10 ft tall (Vines, 1960)  
FRUIT: A follicle 1/4-1/2" in length 2-4 seeded (Vines, 1960)

#### PROCUREMENT

SEEDS/LB: 454,000-1,666,000--avg 1,045,000 (Gill & Pogge, 1974b); 73,000-1,661,000 (Swingle, 1939)  
SEED MATURITY: Aug-Oct WV (Gill & Pogge, 1974b); Sep-Oct AK (Vines, 1960); Fall (Swingle, 1939)  
METHOD OF COLLECTION: Hand pick or strip onto drop cloth (Gill & Pogge, 1974b)  
METHOD OF CLEANING: Dry, thresh and clean (Gill & Pogge, 1974b)

#### PRETREATMENT

METHOD OF STORAGE: Store dry at room temperature (Gill & Pogge, 1974b; Swingle, 1939)  
STRATIFICATION AND SCARIFICATION: May benefit from moist chill treatment (Swingle, 1939)

#### LABORATORY GERMINATION

COMMENTS: Germination capacity low due to large percentage of unsound seed (Gill & Pogge, 1974b)

#### CULTURAL PRACTICES

PLANTING TIME: Fall (Gill & Pogge, 1974b); Fall or spring (Swingle, 1939)  
EXPOSURE: Sun or thin shade (Gill & Pogge, 1974b)  
SOIL TEXTURE: Sandy or rocky soils (Vines, 1960)  
SOIL pH: 7.0 (Gill & Pogge, 1974b)  
GREENHOUSE PLANTING: Reproduces well from hardwood cuttings (Vines, 1960; Swingle, 1939)

NURSERY PLANTING: Mulch (Gill & Pogge, 1974b; Swingle, 1939); Should get 30,000 plants from 1 lb of seed (Gill & Pogge, 1974b)

*POTENTILLA FRUTICOSA* L.  
(Shrubby Cinquefoil)

FAMILY: Rosaceae  
LIFEFORM: Native shrub 30-100 cm tall (Harrington, 1964)  
FRUIT: Densely hairy achene 2 mm long (Harrington, 1964)

#### CULTURAL PRACTICES

EXPOSURE: Semi-shade (Stark, 1966)  
SOIL TEXTURE: Medium (Stark, 1966)  
SOIL DEPTH: Deep (Stark, 1966)  
SOIL MOISTURE: Moist (Stark, 1966)  
SOIL DRAINAGE: Well drained (Stark, 1966)  
FIELD PLANTING: May be difficult to establish from seed (Stark, 1966)

*PRUNUS AMERICANA* Marsh  
(American Plum)

FAMILY: Rosaceae  
LIFEFORM: Native tall shrub or small tree to 5 m tall (Harrington, 1964)  
FRUIT: A one-seeded drupe 1.5-2.5 cm long with a stone 20-30 mm in diameter (Grisez, 1974; Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 550-1,500--avg 870 (Grisez, 1974); 810 (Plummer et al., 1968); 600-1,300 (Swingle, 1939)  
SEED MATURITY: Jun-Oct (Grisez, 1974); Sep 5-Oct 5 UT (Plummer et al., 1968); Summer to late summer (Swingle, 1939)  
METHOD OF COLLECTION: Hand pick or strip into container or onto canvas (Grisez, 1974); Knock from plants or strip into container (Plummer et al., 1968)  
METHOD OF CLEANING: Hammermill at low speed in water and screen (Grisez, 1974); Dybvig with water and dry (Plummer et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: Store in just below surface dry conditions at 34°F (Grisez, 1974; Plummer et al., 1968); In a moist room at 7-10°C (Giersbach & Crocker, 1932)  
DURATION OF GOOD VIABILITY: 5 years (Plummer et al., 1968); 4 1/2 years (Giersbach & Crocker, 1932)  
STRATIFICATION AND SCARIFICATION: Moist chill at 36-41°F for 90-150 days (Grisez, 1974; Roe, 1941); Moist chill at 41°F for 150 days (Babb, 1959); Moist chill at 41°F for 150-180 days (Swingle, 1939); Moist chill at 5°C for 5 months (Giersbach & Crocker, 1932)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 50°F (Grisez, 1974; Roe, 1941); Constant at 5°C (Giersbach & Crocker, 1932)  
GERMINATIVE ENERGY: 67% in 33 days (Roe, 1941)  
GERMINATIVE CAPACITY: 60% in 60 days (Grisez, 1974); 86% in 60 days (Roe, 1941); 43% (Swingle, 1939); 52-71% in 150-180 days (Giersbach & Crocker, 1932)  
COMMENTS: Seed from northern Minnesota germinates better at 50°F while seed from Nebraska did better at 80°F day and 70°F night [Grisez, 1974]

#### CULTURAL PRACTICES

PLANTING DEPTH: 1-2" (Grisez, 1974)  
PLANTING TIME: Fall or spring with stratified seed (Grisez, 1974; Swingle, 1939); Spring (Stark, 1966); Spring with stratified seed (Giersbach & Crocker, 1932)  
EXPOSURE: Sun (Sutton & Johnson, 1974); Sun or shade (Stark, 1966)  
SOIL TEXTURE: Medium (Sutton & Johnson, 1974)  
SOIL pH: 7.0 (Sutton & Johnson, 1974)  
SOIL DEPTH: Moderate (Sutton & Johnson, 1974)  
SOIL MOISTURE: Dry to moist (Stark, 1966)  
ORGANIC MATTER: Yes (Sutton & Johnson, 1974)  
DRAINAGE: Well drained (Stark, 1966)  
GREENHOUSE PLANTING: Reproduces well by cuttings (Swingle, 1939)  
NURSERY PLANTING: Rodents must be kept out of nursery, sow 4 seeds per square foot (Grisez, 1974); Sow seeds in cold frame in late November and mulch the seedbed (Giersbach & Crocker, 1932)

*PRUNUS BESSEYI* Bailey  
(Bessey Cherry)

FAMILY: Rosaceae  
LIFEFORM: Native shrub to 1.5 m tall (Harrington, 1964)  
FRUIT: A one-seeded drupe 12-18 mm in diameter (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 1,500-4,000--avg 2,400 (Grisez, 1974); 2,965 (Plummer et al., 1968); 1,500-2,264 (Swingle)  
SEED MATURITY: Jul-Sep NB (Grisez, 1974); Aug 1-Sep 15 UT (Plummer et al., 1968); Summer (Swingle, 1939)  
METHOD OF COLLECTION: Hand pick or strip into container or onto canvas (Grisez, 1974); Beat bushes with a canvas underneath (Plummer et al., 1968)  
METHOD OF CLEANING: Dybvig with water and dry (Plummer et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: Store at just below surface dry condition in sealed containers at 34°F (Grisez, 1974; Swingle, 1939)

DURATION OF GOOD VIABILITY: 5 years (Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Moist chill at 36-41°F for 120 days (Grisez, 1974); Moist chill at 41°F for 100 days (Babb, 1959); Sow in soil out of doors over winter (Adams, 1927)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 72% in 60 days (Grisez, 1974); 72% (Swingle, 1939); 80% in 685 days (Adams, 1927)

#### CULTURAL PRACTICES

PLANTING TIME: Fall or with stratified seed in spring (Grisez, 1974; Swingle, 1939); Spring (Stark, 1966)  
EXPOSURE: Sun (Stark, 1966)  
SOIL MOISTURE: Moderately moist (Stark, 1966)  
DRAINAGE: Well drained (Stark, 1966)  
GREENHOUSE PLANTING: Reproduces well by cuttings (Swingle, 1939)  
NURSERY PLANTING: Rodents must be kept out of nursery, plant 6-7 seeds per square foot (Grisez, 1974)

*PRUNUS PENNSYLVANICA* L. F.  
(Pincherry)

FAMILY: Rosaceae  
LIFEFORM: Native shrub or small tree to 5 m tall (Harrington, 1964)  
FRUIT: A one-seeded drupe 6-7 mm wide (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 8,000-21,800--avg 14,200 (Grisez, 1974); 21,760 (Swingle, 1939)  
SEED MATURITY: Late Jul-Early Aug PA (Grisez, 1974); Summer (Swingle, 1939)  
METHOD OF COLLECTION: Hand pick or strip into container or onto canvas (Grisez, 1974)  
METHOD OF CLEANING: Hammermill at low speed in water and screen (Grisez, 1974)

#### PRETREATMENT

METHOD OF STORAGE: Store at just below dry surface condition in sealed containers at 34°F (Grisez, 1974); Dry storage at room temperature shortens afterripening period (Hargrave, 1937)  
STRATIFICATION AND SCARIFICATION: Warm stratify at 68°F for 60 days then moist chill at 36-41°F for 120 days (Grisez, 1974); Warm stratify at 77°F for 60 days then moist chill at 41°F for 90 days (Babb, 1959)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating at 77°F day and 50°F night (Grisez, 1974)  
GERMINATIVE CAPACITY: 62% in 60 days (Grisez, 1974); 34% in 270 days (Hargrave, 1937)



### CULTURAL PRACTICES

PLANTING TIME: Fall or stratified seed in spring (Grisez, 1974; Swingle, 1939)  
GREENHOUSE PLANTING: Reproduces well from cuttings (Swingle, 1939)  
FIELD PLANTING: Rodents must be kept out of nursery (Grisez, 1974)

*PRUNUS VIRGINIANA* L.  
(Common Chokecherry)

FAMILY: Rosaceae  
LIFEFORM: Native shrub or small tree to 10 m tall (Harrington, 1964)  
FRUIT: A one-seeded drupe 3-6 mm long (Harrington, 1964)

### PROCUREMENT

SEEDS/LB: 3,010-8,400--avg 4,790 (Grisez, 1974); 4,150 (Plummer et al., 1968); 3,320-8,400 (Swingle, 1939)  
SEED MATURITY: Early Aug PA, Aug-Sep CA, Jul-Oct eastern U.S. (Grisez, 1974); Jul 25-Sep 15 UT (Plummer et al., 1968); Summer (Swingle, 1939)  
METHOD OF COLLECTION: Hand pick or strip into container or onto canvas (Grisez, 1974); Beat bushes with a canvas underneath (Plummer et al., 1968)  
METHOD OF CLEANING: Dybvig with water and dry (Plummer et al., 1968)

### PRETREATMENT

METHOD OF STORAGE: Store at just below surface dry condition in sealed containers at 34°F (Grisez, 1974)  
DURATION OF GOOD VIABILITY: 5 years (Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Moist chill at 36-41°F for 120-160 days (Grisez, 1974); Moist chill at 41°F for 100 days (Babb, 1959); Moist chill November thru March (Swingle, 1939)

### LABORATORY GERMINATION

TEMPERATURE: Alternating at 77°F day and 50°F night (Grisez, 1974)  
GERMINATIVE ENERGY: 53% in 60 days (Monsen & Christensen, 1975)  
GERMINATIVE CAPACITY: 81% in 120 days (Monsen & Christensen, 1975); 77% in 40 days (Grisez, 1974); 84% (Swingle, 1939)

### CULTURAL PRACTICES

PLANTING DEPTH: 1/2" (Grisez, 1974)  
PLANTING TIME: Fall or with stratified seed in spring (Grisez, 1974; Swingle, 1939); Apr (Stark, 1966)  
EXPOSURE: Sun or shade (Sutton & Johnson, 1974)  
SOIL TEXTURE: Medium to coarse (Sutton & Johnson, 1974)

SOIL pH: 7.0 (Sutton & Johnson, 1974)  
SOIL DEPTH: Moderate (Sutton & Johnson, 1974)  
SOIL MOISTURE: Moist (Sutton & Johnson, 1974)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Well drained (Sutton & Johnson, 1974)  
GREENHOUSE PLANTING: Reproduces well from cuttings (Swingle, 1939)  
NURSERY PLANTING: Rodents must be kept out of nursery, plant 25 seeds per square foot (Grisez, 1974)

*PURSHIA TRIDENTATA* (Pursh) DC.  
(Antelope Bitterbrush)

FAMILY: Rosaceae  
LIFEFORM: Native shrub to 300 cm tall (Harrington, 1964)  
FRUIT: An achene 8-12 mm long (Harrington, 1964)

### PROCUREMENT

SEEDS/LB: 13,400-19,000--avg 15,400 (Deitschman et al., 1974d); 15,370 (Plummer et al., 1968); 18,000-24,000 (Hormay, 1943); 22,600 (Swingle, 1939); 18,000 (Mirov & Kraebel, 1937)  
SEED MATURITY: Jul-Early Aug (Deitschman et al., 1974d; Hormay, 1943); Jun 25-Aug 15 UT (Plummer et al., 1968); Early summer (Swingle, 1939); Jul-Sep CA (Mirov & Kraebel, 1937)  
METHOD OF COLLECTION: Dewing machine, fan (Deitschman et al., 1974d); Fan, Crippen EP-27, fan (Plummer et al., 1968)

### PRETREATMENT

METHOD OF STORAGE: Store dry and cool, 41°F, in burlap bags (Deitschman et al., 1974d; Hormay, 1943)  
DURATION OF GOOD VIABILITY: 5 years (Deitschman et al., 1974d; Plummer et al., 1968); 14 years (Hull, 1973)  
STRATIFICATION AND SCARIFICATION: Moist chill at 2°C for 4 weeks (Evans & Young, 1977); Moist chill at 35°F for 60-90 days (Neal & Sanderson, 1975); Moist chill for 1/2-3 months (Deitschman et al., 1974d); Soak in water for 2 days and germinate in 0.2% thiourea (Harper, 1970); Moist chill at 34-38°F for 30 days (McConnell, 1960); Moist chill at 31-41°F for 49-70 days, or a 50 minute soak in sulfuric acid cancels the need for stratification (Boyd, 1954); Hot water treatment inhibited germination (Peterson, 1953); Moist chill at 32-41°F for 6 weeks (Housley, 1952); Moist chill at 32-41°F for 5-8 weeks (Hormay, 1943); Moist chill for 3 months (Mirov & Kraebel, 1937)

### LABORATORY GERMINATION

TEMPERATURE: Alternating at 10-30°C day and 2-5°C night (Evans & Young, 1977); Constant

at 32-38°F (Deitschman et al., 1974d); Alternating at 30°C day and 10°C night (Harper, 1970; Heit, 1968, 1970; McHenry & Jensen, 1967); Constant at 70°F (McConnell 1960; Hormay, 1943)

MOISTURE: Best at 0 bars tension, will germinate with as low as 4 bars tension (Young & Evans, 1976)

LIGHT: Does not require light (Heit, 1968); Best germination in light (McHenry & Jensen, 1967)

GERMINATIVE ENERGY: 32% in 14 days (Peterson, 1953)

GERMINATIVE CAPACITY: 83-86% in 90 days (Deitschman et al., 1974d); 73% in 14 days (Harper, 1970); 64-91% (Heit, 1970); 60% in 25 days (McHenry & Jensen, 1967); 80% in 15 days (Nord, 1965); 37% in 35 days (Peterson, 1953); 69% (Swingle, 1939); 69% in 90 days (Mirov & Kraebel, 1937)

COMMENTS: Stratification and thiourea treatments significantly improve germination (Evans & Young, 1977; Harper, 1970; Nord, 1965); 0.2% potassium nitrate solution improves germination (McHenry & Jensen, 1967); Dormancy is due to seed coat (Nord, 1965); Gibberellic acid improves germination only on unstratified seed (McConnell, 1960); Tetrazolium staining is not satisfactory for determining viability (Boyd, 1954); Susceptible to damping-off fungus (Peterson, 1953; Housley, 1952)

#### CULTURAL PRACTICES

PLANTING DEPTH: Drill (Evans & Young, 1977); On heavier soils 1" and lighter soils 1 1/2" (Hubbard, 1964, 1956); 1/2-1 1/2" depending on moisture (Hubbard & Sanderson, 1961); 1/2" on coarse sandy loam and 3/4" on steep slopes (Basile & Holmgren, 1957); 1/4-1 1/4" (Hormay, 1943)

PLANTING TIME: Untreated seed in fall, treated seed in fall or spring (Evans & Young, 1977; Hubbard, 1964; Hormay, 1943); Late fall or winter (Deitschman et al., 1974d); Apr-May (Stark, 1966); Fall on dry site with light soil (Hubbard, 1964); Time of planting varies with site and rainfall (Hubbard & Sanderson, 1961)

EXPOSURE: Sun (Sutton & Johnson, 1974; Hormay, 1943)

SOIL TEXTURE: Rocky (Sutton & Johnson, 1974); Variable (Stark, 1966)

SOIL pH: 6.0-7.5 (Stark, 1966)

SOIL DEPTH: Moderate to deep, 20-60" (Stark, 1966)

SOIL MOISTURE: Dry (Sutton & Johnson, 1974)

PRECIPITATION: 2-25" (15-62.5 cm) (Stark, 1966)

ORGANIC MATTER: No (Sutton & Johnson, 1974)

DRAINAGE: Well drained (Sutton & Johnson, 1974)

GREENHOUSE PLANTING: Reproduces well from cuttings (Swingle, 1939)

FIELD PLANTING: Soak seed in 3% thiourea solution at 60-140°F for 5 minutes before planting (Neal & Sanderson, 1975; Hubbard & Peterson, 1958; Pearson, 1957); Use of hydrogen peroxide treated seed may

increase seedling survival through avoidance of frost kill by a two-week delay in germination (Everett & Meeuwig, 1975); Mix seed 3 lb to 8 lb rice hulls in drill (Hubbard, 1964); Stratified seed packed in ice will keep for 7-10 days (Hormay, 1943)

*QUERCUS GAMBELLII* Nutt.  
(Gambel Oak)

FAMILY: Fagaceae  
LIFEFORM: Native shrub to small tree 3-5 m tall (Harrington, 1964)  
FRUIT: An acorn 12-20 mm long (Harrington, 1964)

#### CULTURAL PRACTICES

PLANTING TIME: Fall (Stark, 1966)  
EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Medium to coarse (Stark, 1966)  
SOIL pH: Found on limestone soil (Stark, 1966)  
SOIL MOISTURE: Dry to moist (Stark, 1966)  
DRAINAGE: Well drained (Stark, 1966)  
NURSERY PLANTING: Easily grown (Stark, 1966)

*QUERCUS TURBINELLA* Greene  
(Shrub Liveoak)

FAMILY: Fagaceae  
LIFEFORM: Native shrub 1-3 m tall (Harrington, 1964)  
FRUIT: An acorn 15-20 mm long (Harrington, 1964)

#### PROCUREMENT

METHOD OF COLLECTION: Collect from ground or beat shrub with canvas underneath (Olsen, 1974b)  
METHOD OF CLEANING: Hand clean and sort or sort by floatation (Olsen, 1974b)

#### PRETREATMENT

METHOD OF STORAGE: Store in cold moist conditions 0-2°C (Hartmann & Kester, 1975)  
DURATION OF GOOD VIABILITY: Impractical to store for more than 6 months (Hartmann & Kester, 1975)  
STRATIFICATION AND SCARIFICATION: Moist chill at 0-2°C for 1-3 months (Hartmann & Kester, 1975)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating at 100°F day and 40°F night (Olsen, 1974b)  
GERMINATIVE CAPACITY: 95% (Olsen, 1974b)



#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4-1" (Olsen, 1974b)  
PLANTING TIME: Fall or with stratified seed  
in spring (Olsen, 1974b); Spring (Stark,  
1966)  
EXPOSURE: Partial shade (Olsen, 1974b); Sun  
(Stark, 1966)  
SOIL TEXTURE: Rocky (Stark, 1966)  
SOIL MOISTURE: Dry (Stark, 1966)  
NURSERY PLANTING: Drill in rows 8-12" apart,  
mulch in fall and remove in spring (Olsen,  
1974b)

*RHAMNUS CATHARTICA* L.  
(Common Buckthorn)

FAMILY: Rhamnaceae  
LIFEFORM: Introduced shrub or low tree 1-8 m  
tall (Harrington, 1964)  
FRUIT: A berry-like drupe 7-9 mm wide with  
2-4 nutlets (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 13,000-28,400--avg 19,100 (Hubbard,  
1974); 23,381 (Swingle, 1939)  
SEED MATURITY: Sep-Oct northeast U.S. (Hub-  
bard, 1974)

#### PRETREATMENT

METHOD OF STORAGE: Store in sealed containers  
at 41°F (Hubbard, 1974)  
STRATIFICATION AND SCARIFICATION: Moist chill  
at 34-41°F for 15 days (Hubbard, 1974);  
Stratification not necessary (Babb, 1959)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating at 86°F day and 68°F  
night (Hubbard, 1974)  
GERMINATIVE CAPACITY: 90% in 30-60 days (Hub-  
bard, 1974)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4-1/2" (Hubbard, 1974)  
PLANTING TIME: Fall (Hartmann & Kester, 1975);  
Spring (Hubbard, 1974)  
GREENHOUSE PLANTING: Reproduces well from  
cuttings (Swingle, 1939)

*RHUS GLABRA* L.  
(Smooth Sumac)

FAMILY: Anacardiaceae  
LIFEFORM: Native shrub 1-2 m tall (Harrington,  
1964)  
FRUIT: A drupe 4 mm long with single bony  
nutlet (Brinkman, 1974f; Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 10,699-30,000--avg 20,300 (Brink-  
man, 1974f); 62,430 (Plummer et al., 1968);  
22,090-34,432 (Swingle, 1939); 28,700  
(McKeever, 1938)  
SEED MATURITY: Sep-Oct (Brinkman, 1974f);  
Aug 5-Mar 30 UT (Plummer et al., 1968);  
Summer to fall (Swingle, 1939)  
METHOD OF COLLECTION: Hand pick (Brinkman,  
1974f); Hand pick seedheads and berry  
clusters into hoppers (Plummer et al.,  
1968)  
METHOD OF CLEANING: Beat in canvas sack, fan,  
macerate with water (Brinkman, 1974f);  
Dybvig with water, dry and fan (Plummer  
et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: Store in sealed containers  
at 32-41°F (Brinkman, 1974f)  
DURATION OF GOOD VIABILITY: 2 1/2 years  
(Brinkman, 1974f); 5 years (Plummer et al.,  
1968)  
STRATIFICATION AND SCARIFICATION: Moist chill  
at 4°C for 2 months (Hartmann & Kester,  
1975); Soak in sulfuric acid at 70°F for  
1-3 hours or soak in water at 212°F for  
2 minutes (Brinkman, 1974f); Soak seed in  
sulfuric acid for 1 hour then moist chill  
at 41°F for 3 days (Babb, 1959); Soak in  
sulfuric acid for 20 minutes (Boyd, 1943);  
Crack seeds by hand (McKeever, 1938)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 68°F (Brinkman,  
1974f)  
LIGHT: Better germination in continuous light  
(Brinkman, 1974f)  
GERMINATIVE ENERGY: 36% in 10 days (Brinkman,  
1974f)  
GERMINATIVE CAPACITY: 58% in 20-60 days  
(Brinkman, 1974f); 58% (Boyd, 1943); 2%  
(Swingle, 1939); 41% in 19 days (McKeever,  
1938)  
COMMENTS: Do not allow seeds to dry out (Hart-  
mann & Kester, 1975); Dormancy is due to  
seed coat (McKeever, 1938)

#### CULTURAL PRACTICES

PLANTING DEPTH: 3/4" (Brinkman, 1974f)  
PLANTING TIME: Fall after scarification  
(Brinkman, 1974f)  
EXPOSURE: Sun (Sutton & Johnson, 1974)  
SOIL TEXTURE: Coarse (Sutton & Johnson, 1974);  
Variable (Stark, 1966)  
SOIL pH: 6.5-7.0 (Sutton & Johnson, 1974)  
SOIL DEPTH: Shallow to moderate (Sutton &  
Johnson, 1974)  
SOIL MOISTURE: Dry to moist (Sutton & Johnson,  
1974)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Well drained (Sutton & Johnson,  
1974)  
GREENHOUSE PLANTING: Reproduces well from  
cuttings (Swingle, 1939)



*RHUS TRILOBATA* Nutt.  
(Skunkbush Sumac)

FAMILY: Anacardiaceae  
LIFEFORM: Native shrub 50-200 cm tall (Harrington, 1964)  
FRUIT: A hairy drupe 6-7 mm long with a single bony nutlet (Brinkman, 1974f; Harrington, 1964)

PROCUREMENT

SEEDS/LB: 24,000-126,000--avg 49,000 (Brinkman, 1974f); 18,895 (Plummer et al., 1968); 10,600-30,000 (Swingle, 1939)  
SEED MATURITY: Aug-Sep (Brinkman, 1974f); Jun 20-Oct 10 UT (Plummer et al., 1968); Summer to early fall (Swingle, 1939)  
METHOD OF COLLECTION: Hand pick (Brinkman, 1974f); Hand pick seed heads and berry clusters into hoppers (Plummer et al., 1968)  
METHOD OF CLEANING: Beat in canvas sack, fan (Brinkman, 1974f); Dybvig with water, dry and fan (Plummer et al., 1968)

PRETREATMENT

METHOD OF STORAGE: Store in sealed containers at 32-41°F (Brinkman, 1974f); Dry (Swingle, 1939)  
DURATION OF GOOD VIABILITY: 5 years (Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Soak in sulfuric acid at 70°F for 1 hour, needs a cold treatment (Brinkman, 1974f); Moist chill at 3-5°C for 1 month (Heit, 1970); Soak in sulfuric acid at 70°F for 1 hour then moist chill at 41°F for 60 days (Babb, 1959); Soak in sulfuric acid at 70°F for 1 hour (Glazebrook, 1941); If not scarified, moist chill for 120 days (Swingle, 1939)

LABORATORY GERMINATION

TEMPERATURE: Alternating at 86°F day and 68°F night (Brinkman, 1974f)  
GERMINATIVE ENERGY: 23% in 90 days (Monsen & Christensen, 1975); 61% in 15 days (Brinkman, 1974f); 70% in 8 days (Glazebrook, 1941)  
GERMINATIVE CAPACITY: 43% in 180 days (Monsen & Christensen, 1975); 76% in 30 days (Brinkman, 1974f); 5-93% (Heit, 1970); 85% in 25 days (Glazebrook, 1941); 16-38% (Swingle, 1939)  
COMMENTS: Degree of hardseededness and internal dormancy vary with seed source so that pretreatments may have to be altered (Heit, 1970)

CULTURAL PRACTICES

PLANTING DEPTH: 1/2" (Brinkman, 1974f)  
PLANTING TIME: Fall after scarification (Brinkman, 1974f); Jan (Stark, 1966); Fall or with stratified seed in the spring (Swingle, 1939)

EXPOSURE: Shade or sun (Sutton & Johnson, 1974)  
SOIL TEXTURE: Medium to coarse (Sutton & Johnson, 1974)  
SOIL pH: 6.5-7.5 (Sutton & Johnson, 1974)  
SOIL DEPTH: Deep (Sutton & Johnson, 1974)  
SOIL MOISTURE: Moist to dry (Stark, 1966)  
PRECIPITATION: 3-5" (7.5-13 cm) (Stark, 1966)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Well drained (Sutton & Johnson, 1974)  
GREENHOUSE PLANTING: Reproduces well from cuttings (Swingle, 1939)  
FIELD PLANTING: Most natural reproduction vegetative (Sanford, 1970)

*RIBES AMERICANUM* Mill.  
(American Black Currant)

FAMILY: Grossulariaceae  
LIFEFORM: Native shrub 100-150 cm tall (Harrington, 1964)  
FRUIT: A berry 6-10 mm in diameter (Harrington, 1964)

PROCUREMENT

SEEDS/LB: 247,000-336,000--avg 313,000 (Pfister, 1974)  
SEED MATURITY: Jun-Sep (Pfister, 1974)  
METHOD OF COLLECTION: Hand pick or strip into container (Pfister, 1974)  
METHOD OF CLEANING: Dry, ferment several days before extraction, macerate in water, dry (Pfister, 1974)

PRETREATMENT

METHOD OF STORAGE: Store dry in sealed containers at 41°F (Pfister, 1974)  
DURATION OF GOOD VIABILITY: 4 years (Pfister, 1974)  
STRATIFICATION AND SCARIFICATION: Moist chill at 28-36°F for 90-120 days (Pfister, 1974); Moist chill at 41-45°F for 200 days (Swingle, 1939); Sow in soil out of doors over winter (Adams, 1927)

LABORATORY GERMINATION

GERMINATIVE CAPACITY: 76% in 30-40 days (Pfister, 1974); 74% (Swingle, 1939); 74% in 202 days (Adams, 1927)

CULTURAL PRACTICES

PLANTING DEPTH: 1/8-1/4" (Pfister, 1974)  
PLANTING TIME: Fall (Pfister, 1974)  
ORGANIC MATTER: Yes (Pfister, 1974)  
NURSERY PLANTING: Sow 40 plants per linear foot, apply 2-3" of mulch (Pfister, 1974)

*RIBES AUREUM* Pursh  
(Golden Currant)

FAMILY: Grossulariaceae  
LIFEFORM: Native shrub 100-300 cm tall (Harrington, 1964)  
FRUIT: A berry 6-10 mm wide (Harrington, 1964)

PROCUREMENT

SEEDS/LB: 200,000-285,000--avg 233,000 (Pfister, 1974); 356,180 (Plummer et al., 1968); 200,000-231,086 (Swingle, 1939)  
SEED MATURITY: Jun-Jul (Pfister, 1974); Jul 20-Aug 10 UT (Plummer et al., 1968); Summer (Swingle, 1939)  
METHOD OF COLLECTION: Hand pick or strip into container (Pfister, 1974); Knock from bushes onto canvas (Plummer et al., 1968)  
METHOD OF CLEANING: Dry, ferment before extraction, macerate in water, dry (Pfister, 1974); Dybvig with water, dry, fan, and float (Plummer et al., 1968)

PRETREATMENT

METHOD OF STORAGE: Store dry in sealed containers at 70°F (Pfister, 1974)  
DURATION OF GOOD VIABILITY: 17 years (Pfister, 1974); 5 years (Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Moist chill at 41°F for 60 days (Pfister, 1974); Moist chill at 41°F for 90 days (Swingle, 1939)

LABORATORY GERMINATION

GERMINATIVE CAPACITY: 63% in 30-40 days (Pfister, 1974)

CULTURAL PRACTICES

PLANTING TIME: Fall (Pfister, 1974); Fall or with stratified seed in spring (Swingle, 1939)  
EXPOSURE: Sun or shade (Sutton & Johnson, 1974)  
SOIL TEXTURE: Coarse to medium (Sutton & Johnson, 1974)  
SOIL pH: 6.5-7.0 (Sutton & Johnson, 1974)  
SOIL DEPTH: Shallow to deep (Sutton & Johnson, 1974)  
SOIL MOISTURE: Moist to dry (Sutton & Johnson, 1974)  
ORGANIC MATTER: Yes (Pfister, 1974)  
DRAINAGE: Well drained (Sutton & Johnson, 1974)  
NURSERY PLANTING: Sow 40 plants per linear foot, apply 2-3" mulch (Pfister, 1974)

*RIBES CEREUM* Dougl.  
(Wax Currant)

FAMILY: Grossulariaceae  
LIFEFORM: Native shrub 50-200 cm tall (Harrington, 1964)

FRUIT: A berry 6-8 mm in diameter (Harrington, 1964)

PROCUREMENT

SEEDS/LB: 201,000-283,000--avg 251,000 (Pfister, 1974)  
SEED MATURITY: Aug (Pfister, 1974)  
METHOD OF COLLECTION: Hand pick or strip into container (Pfister, 1974)  
METHOD OF CLEANING: Dry, ferment before extraction, macerate in water, dry (Pfister, 1974)

PRETREATMENT

METHOD OF STORAGE: Store dry in sealed containers at 70°F (Pfister, 1974)  
DURATION OF GOOD VIABILITY: 27 years (Pfister, 1974)  
STRATIFICATION AND SCARIFICATION: Moist chill at 28-32°F for 120-150 days (Pfister, 1974)

LABORATORY GERMINATION

TEMPERATURE: Constant at 70°F (Griswald, 1936)  
GERMINATIVE CAPACITY: 72% in 30-40 days (Pfister, 1974); 98% in 70 days (Griswald, 1936)

CULTURAL PRACTICES

PLANTING DEPTH: 1/4-1/2" (Pfister, 1974)  
PLANTING TIME: Fall (Pfister, 1974)  
EXPOSURE: Sun (Sutton & Johnson, 1974)  
SOIL TEXTURE: Medium to coarse (Sutton & Johnson, 1974)  
SOIL pH: 7.0 (Sutton & Johnson, 1974)  
SOIL DEPTH: Moderate to shallow (Sutton & Johnson, 1974)  
SOIL MOISTURE: Dry (Sutton & Johnson, 1974)  
ORGANIC MATTER: Yes (Pfister, 1974)  
DRAINAGE: Well drained (Sutton & Johnson, 1974)  
NURSERY PLANTING: Sow 40 plants per linear foot, apply 2-3" of mulch (Pfister, 1974)

*RIBES INERME* Rydb.  
(Whitestem Gooseberry)

FAMILY: Grossulariaceae  
LIFEFORM: Native shrub to 100 cm tall (Harrington, 1964)  
FRUIT: A berry approx 8 mm in diameter (Harrington, 1964)

PROCUREMENT

SEEDS/LB: 354,000-398,000--avg 366,000 (Pfister, 1974)  
METHOD OF COLLECTION: Hand pick or strip into container (Pfister, 1974)  
METHOD OF CLEANING: Dry, ferment before extraction, macerate in water, dry (Pfister, 1974)

#### PRETREATMENT

METHOD OF STORAGE: Store dry in sealed containers at 70°F (Pfister, 1974)  
DURATION OF GOOD VIABILITY: 11 years (Pfister, 1974)  
STRATIFICATION AND SCARIFICATION: Moist chill at 32°F for 120-200 days (Pfister, 1974)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 74% in 30-40 days (Pfister, 1974)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/8-1/4" (Pfister, 1974)  
PLANTING TIME: Fall (Pfister, 1974)  
ORGANIC MATTER: Yes (Pfister, 1974)  
NURSERY PLANTING: Sow 40 plants per linear foot, apply 2-3" of mulch (Pfister, 1974)

*RIBES LACUSTRE* (Pers.) Poir  
(Prickly Currant)

FAMILY: Grossulariaceae  
LIFEFORM: Native shrub less than 100 cm tall (Harrington, 1964)  
FRUIT: A berry 6-10 mm in diameter (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 515,000 (Pfister, 1974)  
SEED MATURITY: Aug (Pfister, 1974)  
METHOD OF COLLECTION: Hand pick or strip into container (Pfister, 1974)  
METHOD OF CLEANING: Dry, ferment before extraction, macerate in water, dry (Pfister, 1974)

#### PRETREATMENT

METHOD OF STORAGE: Store dry in sealed container (Pfister, 1974)  
STRATIFICATION AND SCARIFICATION: Moist chill at 32°F for 120-200 days (Pfister, 1974)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 61% in 30-40 days (Pfister, 1974)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/8-1/4" (Pfister, 1974)  
PLANTING TIME: Fall (Pfister, 1974)  
ORGANIC MATTER: Yes (Pfister, 1974)  
NURSERY PLANTING: Sow 40 plants per square foot, apply 2-3" of mulch (Pfister, 1974)

*RIBES MONTIGENUM* McClatchie  
(Gooseberry Currant)

FAMILY: Grossulariaceae  
LIFEFORM: Native shrub 30-60 cm tall (Harrington, 1964)  
FRUIT: A berry 6-10 mm long (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 142,000 (Pfister, 1974); 185,595 (Plummer et al., 1968)  
SEED MATURITY: Aug-Sep (Pfister, 1974); Aug 15-Sep 30 UT (Plummer et al., 1968)  
METHOD OF COLLECTION: Hand pick or strip into container (Pfister, 1974)  
METHOD OF CLEANING: Dry, ferment before extraction, macerate in water, dry (Pfister, 1974)

#### PRETREATMENT

METHOD OF STORAGE: Store dry in sealed container (Pfister, 1974)  
STRATIFICATION AND SCARIFICATION: Moist chill at 32°F for 200-300 days (Pfister, 1974)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 17% (Griswald, 1936)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/8-1/4" (Pfister, 1974)  
PLANTING TIME: Fall (Pfister, 1974)  
EXPOSURE: Sun or shade (Sutton & Johnson, 1974)  
SOIL TEXTURE: Moderate to coarse (Sutton & Johnson, 1974)  
SOIL pH: 6.0-7.0 (Sutton & Johnson, 1974)  
SOIL DEPTH: Moderate (Sutton & Johnson, 1974)  
SOIL MOISTURE: Moist (Sutton & Johnson, 1974)  
ORGANIC MATTER: Yes (Pfister, 1974)  
DRAINAGE: Well drained (Sutton & Johnson, 1974)  
NURSERY PLANTING: Sow 40 plants per square foot, apply 2-3" of mulch (Sutton & Johnson, 1974)

*RIBES VISCOSISSIMUM* Pursh  
(Sticky Currant)

FAMILY: Grossulariaceae  
LIFEFORM: Native shrub 80-150 cm tall (Harrington, 1964)  
FRUIT: A berry approx 1 cm in diameter (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 255,000-349,000--avg 298,000 (Pfister, 1974)  
SEED MATURITY: Aug-Sep (Pfister, 1974)  
METHOD OF COLLECTION: Hand pick or strip into container (Pfister, 1974)



METHOD OF CLEANING: Dry, ferment before extraction, macerate in water, dry (Pfister, 1974)

#### PRETREATMENT

METHOD OF STORAGE: Store dry in sealed containers at 70°F (Pfister, 1974)  
DURATION OF GOOD VIABILITY: 17 years (Pfister, 1974)  
STRATIFICATION AND SCARIFICATION: Moist chill at 28-32°F for 140 days (Pfister, 1974)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 67% in 30-40 days (Pfister, 1974)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/8-1/4" (Pfister, 1974)  
PLANTING TIME: Fall (Pfister, 1974)  
EXPOSURE: Sun or shade (Sutton & Johnson, 1974)  
SOIL TEXTURE: Medium (Sutton & Johnson, 1974)  
SOIL pH: 6.5-7.0 (Sutton & Johnson, 1974)  
SOIL DEPTH: Deep (Sutton & Johnson, 1974)  
SOIL MOISTURE: Moist (Sutton & Johnson, 1974)  
ORGANIC MATTER: Yes (Pfister, 1974)  
DRAINAGE: Well drained (Sutton & Johnson, 1974)  
NURSERY PLANTING: Sow 40 plants per linear foot, apply 2-3" of mulch (Pfister, 1974)

*ROSA ACICULARIS* Lindl.  
(Prickly Rose)

FAMILY: Rosaceae  
LIFEFORM: Native shrub 30-200 cm tall (Harrington, 1964)  
FRUIT: A stony achene within a berry-like hip (Harrington, 1964)

#### PROCUREMENT

METHOD OF COLLECTION: Hand pick into containers (Gill & Pogge, 1974c)  
METHOD OF CLEANING: Macerate in water, and float (Gill & Pogge, 1974c)

#### PRETREATMENT

METHOD OF STORAGE: Sealed container at 2-3°C (Densmore & Zasada, 1977)  
STRATIFICATION AND SCARIFICATION: Warm stratify at 25°C for 115 days then moist chill at 5°C for 80-90 days, scarification not necessary if stratified (Densmore & Zasada, 1977); Soak in sulfuric acid for 1-2 hours then moist chill at 41°F for 90 days (Babb, 1959)

#### LABORATORY GERMINATION

TEMPERATURE: Either constant at 20°C or alternating at 20°C day and 10°C night (Densmore & Zasada, 1977)

GERMINATIVE ENERGY: 60% in 15 days (Densmore & Zasada, 1977)  
GERMINATIVE CAPACITY: 92% in 28 days (Densmore & Zasada, 1977)

#### CULTURAL PRACTICES

PLANTING DEPTH: 2 cm (Densmore & Zasada, 1977)  
PLANTING TIME: Spring for germination 1 year later (Densmore & Zasada, 1977)

*ROSA ARKANSANA* Porter  
(Arkansas Rose)

FAMILY: Rosaceae  
LIFEFORM: Native shrub 10-40 cm tall (Harrington, 1964)  
FRUIT: A stony achene within a berry-like hip (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 24,540 (Swingle, 1939)

*ROSA MULTIFLORA* Thunb.  
(Multiflora Rose)

FAMILY: Rosaceae  
LIFEFORM: Introduced shrub (Bailey, 1949)  
FRUIT: A stony achene within a berry-like hip (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 50,000-81,536 (Swingle, 1939)

#### PRETREATMENT

STRATIFICATION AND SCARIFICATION: Moist chill at 40°F for 2 weeks (Stark, 1966); Soak in sulfuric acid for 1-2 hours then moist chill at 41°F for 75 days (Babb, 1959); Moist chill at 40°F for 60 days (Swingle, 1939)

#### CULTURAL PRACTICES

PLANTING TIME: Early spring (Swingle, 1939)  
SOIL TEXTURE: Variable (Stark, 1966)  
SOIL DEPTH: Moderate to deep (Stark, 1966)  
SOIL MOISTURE: Moist to dry (Stark, 1966)  
NURSERY PLANTING: Easily grown

*ROSA NUTKANA* Presl.  
(Nootka Rose)

FAMILY: Rosaceae  
LIFEFORM: Native shrub usually over 100 cm (Harrington, 1964)  
FRUIT: A stony achene within a berry-like hip (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 30,000-60,000 (Gill & Pogge, 1974c); 30,000-53,146 (Swingle, 1939); 60,200 (McKeever, 1938); 30,000 (Mirov & Kraebel, 1937)  
SEED MATURITY: Aug-Sep northern ID (Gill & Pogge, 1974c); Fall (Swingle, 1939); Sep CA (Mirov & Kraebel, 1937)  
METHOD OF COLLECTION: Hand pick into container (Gill & Pogge, 1974c)  
METHOD OF CLEANING: Macerate in water and float (Gill & Pogge, 1974c)

#### PRETREATMENT

METHOD OF STORAGE: Store dry in sealed containers at 34-38°F (Gill & Pogge, 1974c); Store dry at 15.5-21°C, exposure of fruit to low temperatures may decrease germination (Semeniuk & Stewart, 1966)  
DURATION OF GOOD VIABILITY: 2-4 years (Gill & Pogge, 1974c); Less than 4 years (King, 1947)  
STRATIFICATION AND SCARIFICATION: Moist chill at 34-41°F for 140 days (Gill & Pogge, 1974c); Store at 1.5-18.5°C for 128 days then moist chill at 4.5°C for 128 days until germination (Semeniuk & Stewart, 1966); Moist chill for 3 months (Swingle, 1939); Moist chill at 4.5°C for 128 days or until germination (McKeever, 1938)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 70°F (Gill & Pogge, 1974c); Constant at 4.5-7°C Semeniuk & Stewart, 1966)  
MOISTURE: Moist (Semeniuk & Stewart, 1966)  
GERMINATIVE CAPACITY: 63% in 36 days (Gill & Pogge, 1974c); 63-72% in 128 days (Semeniuk & Stewart, 1966); 50% (Swingle, 1939); 44% in 18 days (McKeever, 1938); 50% in 100 days Mirov & Kraebel, 1937)  
COMMENTS: Dormancy due to dormant or immature embryo (McKeever, 1938)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4-3/4" (Gill & Pogge, 1974c)  
PLANTING TIME: Fall (Gill & Pogge, 1974c); Spring (Swingle, 1939)  
EXPOSURE: Sun (Sutton & Johnson, 1974)  
SOIL TEXTURE: Coarse (Sutton & Johnson, 1974)  
SOIL pH: 6.0-7.0 (Sutton & Johnson, 1974)  
SOIL DEPTH: Shallow to moderate (Sutton & Johnson, 1974)  
SOIL MOISTURE: Moist (Sutton & Johnson, 1974)  
ORGANIC MATTER: If possible (Sutton & Johnson, 1974)  
DRAINAGE: Well drained (Sutton & Johnson, 1974)  
NURSERY PLANTING: Apply mulch (Sutton & Johnson, 1974)

*ROSA WOODSII* Lindl.  
(Woods Rose)

FAMILY: Rosaceae  
LIFEFORM: Native shrub 50-300 cm tall (Harrington, 1964)  
FRUIT: A stony achene 3-4 mm long within a berry-like hip 6-15 mm wide (Blauer et al., 1975)

#### PROCUREMENT

SEEDS/LB: 35,000-65,000--avg 50,000 (Gill & Pogge, 1974c); 45,300 (Plummer et al., 1968)  
SEED MATURITY: Jul 1-Aug 15 SD (Gill & Pogge, 1974c); Sep 1-Nov 30 UT (Plummer et al., 1968)  
METHOD OF COLLECTION: Hand pick into container (Gill & Pogge, 1974c); Knock or beat into hoppers or containers (Plummer et al., 1968)  
METHOD OF CLEANING: Macerate in water and float off pulp (Gill & Pogge, 1974c); Dybvig with water, dry, and fan (Plummer et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: Store dry in sealed containers at 34-38°F (Gill & Pogge, 1974c)  
DURATION OF GOOD VIABILITY: 2-4 years (Gill & Pogge, 1974c); 5 years (Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Moist chill one month (Milstein & Milstein, 1976); Warm stratify then cold stratify (Gill & Pogge, 1974c)

#### LABORATORY GERMINATION

LIGHT: Best in light (Milstein & Milstein, 1976)  
GERMINATIVE CAPACITY: Complete in 30-40 days (Milstein & Milstein, 1976)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4-3/4" (Gill & Pogge, 1974c)  
PLANTING TIME: Fall (Gill & Pogge, 1974c)  
EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Medium to moderately fine (Stark, 1966)  
SOIL pH: Slight saline-alkaline tolerance (Stark, 1966)  
SOIL DEPTH: Deep (Stark, 1966)  
SOIL MOISTURE: Dry to moist (Stark, 1966)  
NURSERY PLANTING: Apply mulch (Gill & Pogge, 1974c)

*RUBUS LEUCODERMIS* Dougl.  
Whitebark Raspberry)

FAMILY: Rosaceae  
LIFEFORM: Native shrub 3-9 feet tall (Vines, 1960)

FRUIT: An aggregate of small drupes up to 3/5" across (Vines, 1960)

#### PROCUREMENT

SEEDS/LB: 422,168 (Swingle, 1939)  
SEED MATURITY: Jul-Sep southwestern U.S.  
(Vines, 1960)

*RUBUS OCCIDENTALIS* L.  
(Blackcap Raspberry)

FAMILY: Rosaceae  
LIFEFORM: Native shrub 3-7 1/2' tall (Vines, 1960)  
FRUIT: An aggregate of drupes up to 3/5" across (Vines, 1960)

#### PROCUREMENT

SEEDS/LB: 286,000-384,000--avg 334,000  
(Brinkman, 1974g); 384,000 (Swingle, 1939)  
SEED MATURITY: Jun-Aug (Brinkman, 1974g);  
Summer (Swingle, 1939)  
METHOD OF COLLECTION: Hand pick into container  
(Brinkman, 1974g)  
METHOD OF CLEANING: Macerate in water, float  
off pulp, screen and dry (Brinkman, 1974g)

#### PRETREATMENT

METHOD OF STORAGE: Store dry at 41°F (Brinkman, 1974g)  
STRATIFICATION AND SCARIFICATION: Soak in  
sulfuric acid for 50-60 minutes then moist  
chill at 36-41°F for 90 days (Brinkman, 1974g)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating at 78-80°F day and  
68-70°F night (Brinkman, 1974g)  
GERMINATIVE ENERGY: 44-78% in 7-8 days  
(Brinkman, 1974g)  
GERMINATIVE CAPACITY: 64% in 30-40 days  
(Brinkman, 1974g)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/8-3/16" (Brinkman, 1974g)  
PLANTING TIME: Late summer or with stratified  
seed in the fall (Brinkman, 1974g)  
GREENHOUSE PLANTING: Reproduces well from  
cuttings (Swingle, 1939)  
NURSERY PLANTING: Drill seed, mulch over  
winter (Brinkman, 1974g)

*RUBUS STRIGOSUS* Michx.  
(American Red Raspberry)

SYNONYMY: *Rubus idaeus strigosus*, *Rubus*  
*idaeus melanolasius*, *Rubus melanolasius*  
FAMILY: Rosaceae  
LIFEFORM: Native shrub 4"-6' tall (Vines,  
1960)

FRUIT: An aggregate of drupes 10-12 mm wide  
(Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 384,000 (Swingle, 1939)  
SEED MATURITY: Jun-Oct southwestern U.S.  
(Vines, 1960)

*SALIX BEBBIANA* Sarg.  
(Bebb Willow)

FAMILY: Salicaceae  
LIFEFORM: Native shrub or small tree 2-8 m  
tall (Harrington, 1964)  
FRUIT: A capsule 6-8 mm long within an ament  
2-4 cm long (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 2,500,000 (Brinkman, 1974h)  
SEED MATURITY: May-Jun (Brinkman, 1974h)  
METHOD OF COLLECTION: Hand pick or collect in  
drifts (Brinkman, 1974h)  
METHOD OF CLEANING: Not necessary (Brinkman,  
1974h)

#### PRETREATMENT

METHOD OF STORAGE: Store moist in sealed con-  
tainers at 32-41°F for one month (Brinkman,  
1974h)  
DURATION OF GOOD VIABILITY: Seed viable up to  
10 days at 70°F and 4-6 weeks moist at 32-  
41°F (Brinkman, 1974h)  
STRATIFICATION AND SCARIFICATION: None  
necessary (Brinkman, 1974h)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating 86°F day and 68°F  
night (Brinkman, 1974h)  
LIGHT: Light is required (Brinkman, 1974h)  
GERMINATIVE ENERGY: 27% in 2 days (Brinkman,  
1974h)  
GERMINATIVE CAPACITY: 28% in 7 days (Brinkman,  
1974h)  
COMMENTS: Viability decreases rapidly with  
age (Brinkman, 1974h)

#### CULTURAL PRACTICES

PLANTING TIME: As soon as seed is ripe  
(Swingle, 1939)  
EXPOSURE: Sun (Sutton & Johnson, 1974)  
SOIL TEXTURE: Medium to coarse (Sutton &  
Johnson, 1974)  
SOIL pH: 7.0 (Sutton & Johnson, 1974)  
SOIL DEPTH: Moderate (Sutton & Johnson, 1974)  
SOIL MOISTURE: Wet (Sutton & Johnson, 1974)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Boggy or wet (Sutton & Johnson,  
1974)



*SALIX EXIGUA* Nutt.  
(Coyote Willow)

FAMILY: Salicaceae  
LIFEFORM: Native shrub or small tree 2-8 m tall (Harrington, 1964)  
FRUIT: A capsule 5 mm long within an ament 3-6 cm long (Harrington, 1964)

PROCUREMENT

SEEDS/LB: 10,000,000 (Brinkman, 1974h)  
SEED MATURITY: Jun-Jul (Brinkman, 1974h)  
METHOD OF COLLECTION: Hand pick or collect in drifts (Brinkman, 1974h)  
METHOD OF CLEANING: None necessary (Brinkman, 1974h)

PRETREATMENT

METHOD OF STORAGE: Store moist in sealed containers at 32-41°F for one month (Brinkman, 1974h)  
DURATION OF GOOD VIABILITY: Seed is viable up to 10 days at 70°F and 4-6 weeks at 32-41°F (Brinkman, 1974h)  
STRATIFICATION AND SCARIFICATION: None necessary (Brinkman, 1974h)

LABORATORY GERMINATION

TEMPERATURE: Constant at 72°F (Brinkman, 1974h)  
LIGHT: Light is required (Brinkman, 1974h)  
GERMINATIVE ENERGY: 83% in 4 days (Brinkman, 1974h)  
GERMINATIVE CAPACITY: 83% in 4 days (Brinkman, 1974h)  
COMMENTS: Viability decreases rapidly with age (Brinkman, 1974h)

CULTURAL PRACTICES

PLANTING TIME: Spring (Stark, 1966); As soon as possible (Swingle, 1939)  
EXPOSURE: Sun (Sutton & Johnson, 1974)  
SOIL TEXTURE: Medium to coarse, variable (Sutton & Johnson, 1974)  
SOIL pH: 7.0-8.0, slight saline-alkaline tolerance (Stark, 1966)  
SOIL DEPTH: Moderate (Sutton & Johnson, 1974)  
SOIL MOISTURE: Moist to wet (Sutton & Johnson, 1974)  
PRECIPITATION: 4-10" (Stark, 1966)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Wet or boggy (Sutton & Johnson, 1974)

*SALIX INTERIOR* Rowlee  
(Sandbar Willow)

FAMILY: Salicaceae  
LIFEFORM: Native shrub or small tree 1-8 m tall (Harrington, 1964)  
FRUIT: A capsule within an ament 2-5 cm long and 1 cm wide (Harrington, 1964)

PROCUREMENT

SEED MATURITY: May-Jun (Brinkman, 1974h)  
METHOD OF COLLECTION: Hand pick or collect in drifts (Brinkman, 1974h)  
METHOD OF CLEANING: None necessary (Brinkman, 1974h)

PRETREATMENT

METHOD OF STORAGE: Store moist in sealed containers at 32-41°F for one month (Brinkman, 1974h)  
DURATION OF GOOD VIABILITY: Seed viable up to 10 days at 70°F and 4-6 weeks moist at 32-41°F (Brinkman, 1974h)  
STRATIFICATION AND SCARIFICATION: None necessary (Brinkman, 1974h)

LABORATORY GERMINATION

TEMPERATURE: Alternating at 85°F day and 70°F night (Brinkman, 1974h)  
LIGHT: Light is required (Brinkman, 1974h)  
GERMINATIVE ENERGY: 80% in 3 days (Brinkman, 1974h)  
GERMINATIVE CAPACITY: 80% in 12 days (Brinkman, 1974h)  
COMMENTS: Viability decreases rapidly with age (Brinkman, 1974h)

CULTURAL PRACTICES

PLANTING TIME: As soon as seed is ripe (Swingle, 1939)

*SALIX PETIOLARIS* J. E. Sm.  
(Meadow Willow)

FAMILY: Salicaceae  
LIFEFORM: Native shrub 2-4 m tall (Harrington, 1964)  
FRUIT: A capsule 3-4 mm long within an ament 1.5-2 cm long and 1 cm wide (Harrington, 1964)

PROCUREMENT

SEEDS/LB: 500,000 (Brinkman, 1974h)  
SEED MATURITY: Jun-Jul (Brinkman, 1974h)  
METHOD OF COLLECTION: Hand pick or collect in drifts (Brinkman, 1974h)  
METHOD OF CLEANING: None necessary (Brinkman, 1974h)

PRETREATMENT

METHOD OF STORAGE: Store moist in sealed containers at 32-41°F for one month (Brinkman, 1974h)  
DURATION OF GOOD VIABILITY: Seed is viable up to 10 days at 70°F and 4-6 weeks moist at 32-41°F (Brinkman, 1974h)  
STRATIFICATION AND SCARIFICATION: None necessary (Brinkman, 1974h)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating at 86°F day and 68°F night (Brinkman, 1974h)  
LIGHT: Light is required (Brinkman, 1974h)  
GERMINATIVE ENERGY: 80% in 2 days (Brinkman, 1974h)  
GERMINATIVE CAPACITY: 82% in 3 days (Brinkman, 1974h)  
COMMENTS: Viability decreases rapidly with age (Brinkman, 1974h)

#### CULTURAL PRACTICES

PLANTING TIME: As soon as seed is ripe (Swingle, 1939)

*SALIX SCOULERIANA* Barratt in Hook.  
(Scouler Willow)

FAMILY: Salicaceae  
LIFEFORM: Native shrub or small tree 3-10 mm tall (Harrington, 1964)  
FRUIT: A capsule 7-9 mm long within an ament 3-8 cm thick (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 6,500,000 (Brinkman, 1974h)  
SEED MATURITY: May-Jul (Brinkman, 1974h); Spring (Swingle, 1939)  
METHOD OF COLLECTION: Hand pick or collect in drifts (Brinkman, 1974h)  
METHOD OF CLEANING: None necessary (Brinkman, 1974h)

#### PRETREATMENT

METHOD OF STORAGE: Store moist in sealed containers at 32-41°F for one month (Brinkman, 1974h)  
DURATION OF GOOD VIABILITY: Seed is viable up to 10 days at 70°F and 4-6 weeks moist at 32-41°F (Brinkman, 1974h)  
STRATIFICATION AND SCARIFICATION: None necessary (Brinkman, 1974h)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating 85°F day and 70°F night (Brinkman, 1974h)  
LIGHT: Light is required (Brinkman, 1974h)  
GERMINATIVE ENERGY: 95% in 1 day (Brinkman, 1974h)  
GERMINATIVE CAPACITY: 95% in 2 days (Brinkman, 1974h)  
COMMENTS: Viability decreases rapidly with age (Brinkman, 1974h)

#### CULTURAL PRACTICES

PLANTING TIME: As soon as seed is ripe (Swingle, 1939)  
EXPOSURE: Sun (Sutton & Johnson, 1974)  
SOIL TEXTURE: Medium (Sutton & Johnson, 1974)  
SOIL pH: 6.5-7.0 (Sutton & Johnson, 1974)

SOIL MOISTURE: Moist to dry (Sutton & Johnson, 1974)

ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Well drained (Sutton & Johnson, 1974)

FIELD PLANTING: Most reproduction in nature is vegetative (Sampson, 1917)

*SAMBUCUS CANADENSIS* L.  
(American Elder)

FAMILY: Caprifoliaceae  
LIFEFORM: Native shrub 1-3 m tall (Harrington, 1964)  
FRUIT: A berry-like pome 4-5 mm in diameter (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 175,000-324,000--avg 232,000 (Brinkman, 1974i); 202,000-468,220 (Swingle, 1939)  
SEED MATURITY: Jul-Sep (Brinkman, 1974i); Summer to fall (Swingle, 1939)  
METHOD OF COLLECTION: Strip or cut clusters of berries from branches (Brinkman, 1974i)  
METHOD OF CLEANING: Macerate with water, float off, dry, fan and screen (Brinkman, 1974i)

#### PRETREATMENT

METHOD OF STORAGE: Store dry at 41°F (Brinkman, 1974i); Seed must be removed from pulp before storage (Davis, 1927)  
DURATION OF GOOD VIABILITY: 2 years (Brinkman, 1974i)  
STRATIFICATION AND SCARIFICATION: Warm stratify at 86°F day and 68°F night for 60 days then moist chill at 41°F for 90-150 days (Brinkman, 1974i); Warm stratify at 77°F for 60 days then moist chill at 41°F for 90 days (Babb, 1959); Layer fresh seed out of doors over winter (Adams, 1927; Rose, 1919); Moist chill at 0-5°C for 85-100 days (Davis, 1927)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating at 86°F day and 68°F night (Brinkman, 1974i); Alternating at 27°C day and 10°C night (Davis, 1927)  
MOISTURE: Moist (Rose, 1919)  
GERMINATIVE ENERGY: 32% in 16 days (Brinkman, 1974i)  
GERMINATIVE CAPACITY: 63% in 60 days (Brinkman, 1974i); 13% (Swingle, 1939); 57% in 25-70 days (Nichols, 1934); 92-95% in 299 days (Adams, 1927); 60-70% (Davis, 1927); 77% (Rose, 1919)  
COMMENTS: Exposure to warm temperatures during stratification will induce secondary dormancy which can be overcome by an additional 130-140 days of cold stratification (Davis, 1927)

## CULTURAL PRACTICES

PLANTING TIME: Immediately after harvest or in spring after stratification (Swingle, 1939); Fall (Adams, 1927; Davis, 1927)  
EXPOSURE: Protect from freezing (Davis, 1927)  
GREENHOUSE PLANTING: Reproduced well from cuttings (Swingle, 1939)

*SAMBUCUS COERULEA* Raf.  
(Blueberry Elder)

SYNONYMY: *Sambucus glauca*  
FAMILY: Caprifoliaceae  
LIFEFORM: Native large shrub or small tree  
2-6 m tall (Harrington, 1964)  
FRUIT: A berry-like drupe 5-6 mm in diameter  
(Harrington, 1964)

## PROCUREMENT

SEEDS/LB: 117,000-259,000--avg 205,000  
(Brinkman, 1974i); 216,770 (Plummer et al., 1968); 117,000-126,088 (Swingle, 1939); 137,400 (McKeever, 1938)  
SEED MATURITY: Aug-Sep (Brinkman, 1974i); Aug 15-Sep 25 UT (Plummer et al., 1968); Late summer (Swingle, 1939)  
METHOD OF COLLECTION: Strip or cut clusters of berries from branches (Brinkman, 1974i); Hand pick into containers (Swingle, 1939)  
METHOD OF CLEANING: Macerate with water, float off, dry, fan, and screen (Brinkman, 1974i); Dybvig with water, dry, fan, and float (Plummer et al., 1968)

## PRETREATMENT

METHOD OF STORAGE: Store dry at 41°F (Brinkman, 1974i); Dry (Swingle, 1939)  
DURATION OF GOOD VIABILITY: 5 years (Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Moist chill at 41°F for 98 days (Brinkman, 1974i); Stratification may help (Stark, 1966; Swingle, 1939); Moist chill in sand at 5°C for 16 weeks to 64 weeks (McKeever, 1938)

## LABORATORY GERMINATION

TEMPERATURE: Constant at 70°F (Brinkman, 1974i)  
GERMINATIVE ENERGY: 20% in 120 days (Monsen & Christensen, 1975); 55% in 12 days (Brinkman, 1974i); 62% in 13 days (McKeever, 1938)  
GERMINATIVE CAPACITY: 33% in 120 days (Monsen & Christensen, 1975); 75% in 35 days (Brinkman, 1974i); 64-80% in 20-23 days (McKeever, 1938)  
COMMENTS: Dormancy is due to dormant or immature embryo (McKeever, 1938)

## CULTURAL PRACTICES

PLANTING TIME: Fall (Monsen & Christensen, 1975); Spring after stratification (Swingle, 1939)  
EXPOSURE: Sun (Sutton & Johnson, 1974)  
SOIL TEXTURE: Medium to coarse (Sutton & Johnson, 1974)  
SOIL pH: 7.0 (Sutton & Johnson, 1974)  
SOIL DEPTH: Deep (Sutton & Johnson, 1974)  
SOIL MOISTURE: Moist-dry (Sutton & Johnson, 1974)  
ORGANIC MATTER: Yes (Sutton & Johnson, 1974)  
DRAINAGE: Well drained (Sutton & Johnson, 1974)  
GREENHOUSE PLANTING: Reproduces fairly well from cuttings (Swingle, 1939)

*SAMBUCUS MELANOCARPA* A. Gray  
(Mountain Elder)

FAMILY: Caprifoliaceae  
LIFEFORM: Native shrub up to 3 m tall (Harrington, 1964)  
FRUIT: A berry-like drupe approx 6 mm in diameter (Harrington, 1964)

## PROCUREMENT

SEED MATURITY: Aug 20-Sep 15 (Sampson, 1917)

## CULTURAL PRACTICES

EXPOSURE: Sun (Sampson, 1917)  
SOIL TEXTURE: Coarse (Sampson, 1917)  
SOIL MOISTURE: Moist (Sampson, 1917)

*SAMBUCUS RACEMOSA* L.  
(Scarlet Elder)

SYNONYMY: *Sambucus pubens*, *Sambucus racemosa* spp. *pubens*, var. *microbotrys*, *Sambucus microbotrys*  
FAMILY: Caprifoliaceae  
LIFEFORM: Native shrub 60-400 cm tall (Harrington, 1964)  
FRUIT: A berry-like drupe approx 5 mm in diameter (Harrington, 1964)

## PROCUREMENT

SEEDS/LB: 192,000-377,000--avg 286,000 (Brinkman, 1974i); 303,000 (Swingle, 1939)  
SEED MATURITY: Jun-Aug (Brinkman, 1974i); Jun-Nov southwest U.S. (Vines, 1960); Summer to fall (Swingle, 1939)  
METHOD OF COLLECTION: Strip or cut clusters from branches (Brinkman, 1974i)  
METHOD OF CLEANING: Macerate with water, float off, dry, fan, and screen (Brinkman, 1974i)



#### PRETREATMENT

METHOD OF STORAGE: Store dry at 41°F (Brinkman, 1974i)  
STRATIFICATION AND SCARIFICATION: Warm stratify at 86°F day and 68°F night for 30-60 days then moist chill at 41°F for 90-150 days (Brinkman, 1974i); Moist chill at 2°C for 5 months (Conrad & McDonough, 1972; McDonough, 1969); Does not need stratification (Nichols, 1934)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating at 86°F day and 68°F night (Brinkman, 1974i); Alternating at 25°C day and 15°C night (Conrad & McDonough, 1972); Alternating at 22°C day and 17°C night (McDonough, 1969); Constant at 70°F (Griswald, 1936)  
GERMINATIVE ENERGY: 50% in 2 days (McDonough, 1969)  
GERMINATIVE CAPACITY: 47% in 60 days (Brinkman, 1974i); 37-51% in 30 days (Conrad & McDonough, 1972); 100% in 28 days (McDonough, 1969); 6% (Griswald, 1936); 51% in 139-252 days (Nichols, 1934)  
COMMENTS: Both a seed coat and embryo dormancy (Vines, 1960)

#### CULTURAL PRACTICES

PLANTING DEPTH: Drill 1/4" (Vines, 1960)  
PLANTING TIME: Fall or with stratified seed in spring (Swingle, 1939)  
EXPOSURE: Seedlings should have half shade (Vines, 1960)  
GREENHOUSE PLANTING: Reproduces well from cuttings (Swingle, 1939)  
FIELD PLANTING: Reproduces best vegetatively (Conrad & McDonough, 1972)

*SARCOBATUS VERMICULATUS* (Hook.) Torr.  
(Black Greasewood)

FAMILY: Chenopodiaceae  
LIFEFORM: Native shrub 30-300 cm tall (Harrington, 1964)  
FRUIT: A utricle with wings 6-13 mm wide (Blauer et al., 1976)

#### PROCUREMENT

SEEDS/LB: 193,000-257,000 (Eddleman, 1977); 285,600 (Blauer et al., 1976)  
SEED MATURITY: Late Sep-mid Nov MT (Eddleman, 1977)  
METHOD OF COLLECTION: Knock seed from plant with flail onto canvas (Eddleman, 1977)  
METHOD OF CLEANING: Mechanical flail, clipper 8/(1/25), seed blower (Eddleman, 1977)

#### LABORATORY GERMINATION

TEMPERATURE: Either constant at 20°C or alternating at 20°C day and 5°C night (Eddleman, 1977)

LIGHT: Light may be beneficial (Eddelman, 1977)  
GERMINATIVE ENERGY: 50% in 1-6 days (Eddleman, 1977)  
GERMINATIVE CAPACITY: 67-72% (Eddleman, 1977); 16% (Swingle, 1939)

#### CULTURAL PRACTICES

EXPOSURE: Sun (Blauer et al., 1976)  
SOIL TEXTURE: Fine (Blauer et al., 1976)  
SOIL pH: High alkali tolerance (Blauer et al., 1976)  
SOIL SALINITY: High salt tolerance (Blauer et al., 1976)  
SOIL MOISTURE: Dry (Blauer et al., 1976)

*SHEPHERDIA ARGENTEA* (Pursh) Nutt.  
(Silver Buffaloberry)

FAMILY: Elaeagnaceae  
LIFEFORM: Native shrub or small tree 2-7 m tall (Harrington, 1964)  
FRUIT: A drupe-like achene 1/8-1/4" long (Thilenius et al., 1974)

#### PROCUREMENT

SEEDS/LB: 18,000-67,000--avg 41,000 (Thilenius et al., 1974); 10,980 (Plummer et al., 1968); 18,000-67,000 (Swingle, 1939); 18,000 (Mirov & Kraebel, 1937)  
SEED MATURITY: Jun-Aug (Thilenius et al., 1974); Late summer or fall (Swingle, 1939); Aug 1-Sep 30 CA (Mirov & Kraebel, 1937)  
METHOD OF COLLECTION: Strip or flail bush onto canvas, use heavy gloves (Thilenius et al., 1974)  
METHOD OF CLEANING: Screen, macerate with water, float-off, dry (Thilenius et al., 1974); Dybvig with water, dry and fan (Plummer et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: Store dry at 41°F (Thilenius et al., 1974)  
DURATION OF GOOD VIABILITY: 4 1/2 years (Thilenius et al., 1974); 5 years (Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Moist chill at 41°F for 90 days (Thilenius et al., 1974); Soak in sulfuric acid for 20-30 minutes, stratification unnecessary after an acid soak although stratification gives more rapid germination (Heit, 1970)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating at 86°F day and 68°F night (Thilenius et al., 1974); Alternating at 30°C day and 20°C night (Heit, 1970)  
LIGHT: Best in light (Heit, 1970)  
GERMINATIVE ENERGY: 93% in 18 days (Thilenius et al., 1974)  
GERMINATIVE CAPACITY: 16% in 60 days (Thilenius et al., 1974); 71-86% in 21 days

(Heit, 1970); 12-78% (Swingle, 1939); 78% in 38 days (Mirov & Kraebel, 1937)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4" (Thilenius et al., 1974)  
PLANTING TIME: Fall or with stratified seed in spring (Swingle, 1939)  
EXPOSURE: Sun (Sutton & Johnson, 1974); Sun or shade (Stark, 1966)  
SOIL TEXTURE: Medium to coarse or fine (Sutton & Johnson, 1974)  
SOIL pH: 7.0-8.0 (Stark, 1966)  
SOIL SALINITY: Slight saline tolerance (Stark, 1966)  
SOIL DEPTH: Deep (Stark, 1966)  
SOIL MOISTURE: Moist to dry (Stark, 1966)  
PRECIPITATION: 6-12" (Stark, 1966)  
ORGANIC MATTER: No (Sutton & Johnson, 1974)  
DRAINAGE: Well drained (Sutton & Johnson, 1974)  
GREENHOUSE PLANTING: Vegetative propagation best with 2" branch tips in a frame with bottom heat (Mirov & Kraebel, 1939); Reproduces well from cuttings (Swingle, 1939)  
NURSERY PLANTING: Apply mulch 1/2-1" deep over seedbed (Thilenius et al., 1974)

*SHEPHERDIA CANADENSIS* (L.) Nutt.  
(Russet Buffaloberry)

FAMILY: Elaeagnaceae  
LIFEFORM: Native shrub 1-3 m tall (Harrington, 1964)  
FRUIT: A drupe-like achene 1/8-1/4" long (Thilenius et al., 1974)

#### PROCUREMENT

SEEDS/LB: 59,215 (Plummer et al., 1968)  
SEED MATURITY: Jun-Aug (Thilenius et al., 1974); Jul 15-Aug 30 UT (Plummer et al., 1968)  
METHOD OF COLLECTION: Strip or flail bush onto canvas (Thilenius et al., 1974)  
METHOD OF CLEANING: Screen, macerate with water, float-off, dry (Thilenius et al., 1974); Dybvig with water, dry, and fan (Plummer et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: Store dry at 41°F (Thilenius et al., 1974)  
DURATION OF GOOD VIABILITY: 5 years (Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: Soak in sulfuric acid for 20-30 minutes (Thilenius et al., 1974); Soak in sulfuric acid for 30 minutes, stratification not necessary after acid soak (Heit, 1970); Moist chill at 1°C for 60 days, scarification not necessary (McLean, 1967); Moist chill at 41°F for 75 days (Babb, 1959)

#### LABORATORY GERMINATION

TEMPERATURE: Alternating at 86°F day and 68°F night (Thilenius et al., 1974); Alternating at 30°C day and 20°C night (Heit, 1970)  
GERMINATIVE CAPACITY: 80% in 21 days (Thilenius et al., 1974); 68% (McLean, 1967)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4" (Thilenius et al., 1974)  
PLANTING TIME: Fall or with stratified seed in spring (Swingle, 1939)  
EXPOSURE: Usually shaded (Harrington, 1964)  
GREENHOUSE PLANTING: Reproduces well from cuttings (Swingle, 1939)  
NURSERY PLANTING: Apply mulch 1/2-1" deep over seedbed (Swingle, 1939)

*SORBUS SCOPULINA* Greene  
(Greene's Mountain Ash)

FAMILY: Rosaceae  
LIFEFORM: Native shrub 4-5 m tall (Harrington, 1964)  
FRUIT: A fleshy 4-seeded pome over 2 cm wide (Harrington, 1964)

#### PROCUREMENT

METHOD OF COLLECTOIN: Hand pick or shake onto canvas (Harris & Stein, 1974)  
METHOD OF CLEANING: Macerate in water, float-off, dry, and fan (Harris & Stein, 1974)

#### PRETREATMENT

METHOD OF STORAGE: Store dry in sealed containers at 34-38°F (Harris & Stein, 1974)  
STRATIFICATION AND SCARIFICATION: Moist chill at 33-41°F for 60 days (Harris & Stein, 1974); Warm stratify at 77°F for 115 days then moist chill at 41°F for 75 days (Babb, 1959)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/16" (Harris & Stein, 1974)  
PLANTING TIME: Fall or early winter (Harris & Stein, 1974); Spring (Stark, 1966)  
EXPOSURE: Sun or shade (Stark, 1966)  
SOIL TEXTURE: Medium (Stark, 1966)  
SOIL DEPTH: Deep (Stark, 1966)  
SOIL MOISTURE: Moist (Stark, 1966)  
ORGANIC MATTER: Yes (Stark, 1966)  
DRAINAGE: Well drained (Stark, 1966)  
FIELD PLANTING: Drill cleaned seed, many seeds will not germinate until 2nd or 3rd season (Harris & Stein, 1974)

*SPIRAEA CAESPITOSA* Nutt.  
(Dwarf Spiraea)

SYNONYMY: *Petrophytum caespitosum*  
FAMILY: Rosaceae  
LIFEFORM: Native prostrate shrub (Harrington, 1964)  
FRUIT: A follicle approx 2 mm long (Harrington, 1964)

CULTURAL PRACTICES

PLANTING TIME: Spring (Stark, 1966)  
SOIL TEXTURE: Medium (Stark, 1966)  
SOIL MOISTURE: Dry to slightly moist (Stark, 1966)  
DRAINAGE: Well drained (Stark, 1966)  
FIELD PLANTING: Not easily grown (Hitchcock & Cronquist, 1973)

*SYMPHORICARPOS ALBUS ALBUS* (L.) Blake  
(Common Snowberry)

SYNONYMY: *Symphoricarpos racemosus*  
FAMILY: Caprifoliaceae  
LIFEFORM: Native shrub 20-80 cm tall (Harrington, 1964)  
FRUIT: A 2-seeded, berry-like drupe 6-10 mm long (Harrington, 1964)

PROCUREMENT

SEEDS/LB: 54,000-113,000--avg 76,000 (Evans, 1974); 65,175 (Glazebrook, 1941); 53,600-95,650 (Swingle, 1939); 54,000, 18,000 dry fruits (Mirov & Kraebel, 1937)  
SEED MATURITY: Aug 1-Sep 5 ID (Evans, 1974); Fall (Swingle, 1939); Oct-Nov CA (Mirov & Kraebel, 1937)  
METHOD OF COLLECTION: Strip or flail clusters from branches onto canvas (Evans, 1974)  
METHOD OF CLEANING: Macerate with water and float-off, dry and fan (Evans, 1974); Depulp in #1 Be-1 hammermill, wash in water, dry at 70°F, clipper clean (Glazebrook, 1941)

PRETREATMENT

METHOD OF STORAGE: Store dry at 41°F (Evans, 1974); Dry in cloth bags at 70°F (Glazebrook, 1941)  
STRATIFICATION AND SCARIFICATION: Soak seed in sulfuric acid for 75 minutes then warm stratify at 86°F for 20 days then moist chill at 41°F for 180 days (Evans, 1974); Soak in sulfuric acid for 75 minutes (Babb, 1959); Warm stratify at 25°C for 3-4 months then moist chill at 5°C for 6 months (Flemion, 1942); Moist chill at least 100-140 days, may benefit from 1 hour soak in sulfuric acid (Glazebrook, 1941); Soak seed in sulfuric acid for 75 minutes, needs both warm and cold stratification (Swingle, 1939); Soak seed in sulfuric acid for 1 hour then moist chill

for 6 months (Mirov & Kraebel, 1937); Sow in soil out of doors over winter (Adams, 1927)

LABORATORY GERMINATION

TEMPERATURE: Alternating at 86°F day and 68°F night (Evans, 1974); Temperature sensitive (Glazebrook, 1941)  
MOISTURE: Moisture sensitive (Glazebrook, 1941)  
GERMINATIVE CAPACITY: 35% in 30 days (Evans, 1974); 2-32% (Glazebrook, 1941); 75% (Swingle, 1939); 50% in 640 days (Adams, 1927)  
COMMENTS: Addition of nitrogen compounds to the peat moss during the period of warm stratification aids germination (Flemion, 1942); Germination may occur during stratification, method of overcoming dormancy poorly understood (Glazebrook, 1941); Germination is enhanced by fungal decay of outer seed coat which is in turn enhanced by a soak in sulfuric acid (Pfeiffer, 1934)

CULTURAL PRACTICES

PLANTING DEPTH: 1/4" (Evans, 1974)  
PLANTING TIME: Fall (Glazebrook, 1941)  
NURSERY PLANTING: Warm stratify seed and sow in fall, mulch with 3/4" sawdust (Evans, 1974); Stems are easily rooted in open (Mirov & Kraebel, 1939)  
FIELD PLANTING: Propagation by seed is difficult, it can easily be propagated by cuttings (Swingle, 1939; Mirov & Kraebel, 1937)

*SYMPHORICARPOS LONGIFLORUS* Gray  
(Longflower Snowberry)

FAMILY: Caprifoliaceae  
LIFEFORM: Native shrub 50-100 cm tall (Harrington, 1964)  
FRUIT: A 2-seeded, berry-like drupe 8-10 mm long (Harrington, 1964)

PROCUREMENT

METHOD OF COLLECTION: Strip or flail clusters from branches onto canvas (Evans, 1974)  
METHOD OF CLEANING: Macerate with water and float-off, dry and fan (Evans, 1974)

PRETREATMENT

METHOD OF STORAGE: Store dry at 41°F (Evans, 1974)

CULTURAL PRACTICES

PLANTING DEPTH: 1/4" (Evans, 1974)  
PLANTING TIME: Sow unstratified seed in fall (Evans, 1974); Spring (Stark, 1966)  
EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Medium to coarse (Stark, 1966)  
SOIL pH: Often on limestone (Stark, 1966)



SOIL DEPTH: 20-60" (Stark, 1966)  
SOIL MOISTURE: Dry (Stark, 1966)  
PRECIPITATION: 8-14" (Stark, 1966)  
NURSERY PLANTING: Stems easily rooted in open (Mirov & Kraebel, 1939)

*SYMPHORICARPOS OCCIDENTALIS* Hook.  
(Western Snowberry)

FAMILY: Caprifoliaceae  
LIFEFORM: Native shrub 50-150 cm tall (Harrington, 1964)  
FRUIT: A 2-seeded, berry-like drupe 6-8 mm long (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 52,000-98,700--avg 74,400 (Evans, 1974); 52,000-77,606 (Swingle, 1939)  
SEED MATURITY: Jun 1-Jul 31 SD (Evans, 1974); Fall (Swingle, 1939)  
METHOD OF COLLECTION: Strip or flail clusters from branches onto canvas (Evans, 1974)  
METHOD OF CLEANING: Macerate with water, float off, dry, and fan (Evans, 1974)

#### PRETREATMENT

METHOD OF STORAGE: Store dry at 41°F (Evans, 1974)  
STRATIFICATION AND SCARIFICATION: Moist chill for 270 days (Evans, 1974)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4" (Evans, 1974)  
PLANTING TIME: Fall (Evans, 1974); Summer or stratify (Swingle, 1939)  
GREENHOUSE PLANTING: Reproduces well from cuttings (Swingle, 1939)  
NURSERY PLANTING: Warm stratify seed and sow in fall, mulch seedbed with 3/4" sawdust (Evans, 1974); Stems easily rooted in open (Mirov & Kraebel, 1939)

*SYMPHORICARPOS ORBICULATUS* Moench  
(Indian Currant)

FAMILY: Caprifoliaceae  
LIFEFORM: Native shrub 2-6 ft tall (Vines, 1960)  
FRUIT: A 2-seeded, berry-like drupe 1/6-1/4" thick (Vines, 1960)

#### PROCUREMENT

SEEDS/LB: 135,000-144,000--avg 140,000 (Evans, 1974); 407,680 (Swingle, 1939)  
SEED MATURITY: Jul 1-Aug 31 (Evans, 1974); Fall (Swingle, 1939)  
METHOD OF COLLECTION: Strip or flail clusters from branches onto canvas (Evans, 1974)  
METHOD OF CLEANING: Macerate with water, float off, dry and fan (Evans, 1974)

#### PRETREATMENT

METHOD OF STORAGE: Store dry at 41°F (Evans, 1974); 10°F (Flemion & Parker, 1942)  
DURATION OF GOOD VIABILITY: 5 years (Flemion & Parker, 1942)  
STRATIFICATION AND SCARIFICATION: Soak seed in sulfuric acid for 30 minutes then warm stratify at 86°F for 120 days then moist chill at 41°F for 180 days (Evans, 1974); Soak seed in sulfuric acid for 30 minutes at 77°F then moist chill at 50°F for 180 days (Babb, 1959); Soak seed in sulfuric acid for 30 minutes then warm stratify at 25°C for 3-4 months then moist chill at 10°C for 4-5 months (Flemion & Parker, 1942)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 5-10°C (Flemion & Parker, 1942)  
GERMINATIVE CAPACITY: 81% in 30 days (Evans, 1974); 70-74% (Flemion & Parker, 1942)

#### CULTURAL PRACTICES

PLANTING DEPTH: 1/4" (Evans, 1974)  
PLANTING TIME: Fall (Evans, 1974); Fall or spring for germination the second year (Swingle, 1939)  
GREENHOUSE PLANTING: Reproduces well from cuttings (Swingle, 1939)  
NURSERY PLANTING: Warm stratify seed in fall, mulch seedbed with 3/4" sawdust (Evans, 1974); Stems easily rooted in open (Mirov & Kraebel, 1939)

*SYMPHORICARPOS OREOPHILUS* Gray  
(Mountain Snowberry)

FAMILY: Caprifoliaceae  
LIFEFORM: Native shrub 1-1.5 m tall (Harrington, 1964)  
FRUIT: A 2-seeded, berry-like drupe 8-10 mm long (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 54,065 (Plummer et al., 1968)  
SEED MATURITY: Aug 10-Sep 15 UT (Plummer et al., 1968); Summer (Swingle, 1939)  
METHOD OF COLLECTION: Strip or knock fruit into hopper or container (Plummer et al., 1968)  
METHOD OF CLEANING: Dybvig with water, dry and fan (Plummer et al., 1968)

#### PRETREATMENT

METHOD OF STORAGE: Dry (Swingle, 1939)  
DURATION OF GOOD VIABILITY: 3 years (Plummer et al., 1968)  
STRATIFICATION AND SCARIFICATION: May need to soak in hot water (Stark, 1966)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 32% (Griswald, 1936)

#### CULTURAL PRACTICES

PLANTING TIME: Sow unstratified seed in fall (Evans, 1974); Spring (Sutton & Johnson, 1974)

EXPOSURE: Sun or shade (Sutton & Johnson, 1974)

SOIL TEXTURE: Medium (Sutton & Johnson, 1974)

SOIL pH: 7.0 (Sutton & Johnson, 1974)

SOIL DEPTH: Moderate (Sutton & Johnson, 1974)

SOIL MOISTURE: Moist or dry (Sutton & Johnson, 1974)

ORGANIC MATTER: No (Sutton & Johnson, 1974)

DRAINAGE: Well drained (Sutton & Johnson, 1974)

NURSERY PLANTING: Stems easily rooted in open (Sutton & Johnson, 1974)

*TAMARIX PENTANDRA* Pall.  
(Fivestamen Tamarisk)

SYNONYMY: *Tamarix gallica*, *Tamarix paryifolia*

FAMILY: Tamaricaceae

LIFEFORM: Introduced shrub or small tree  
3-8 m tall (Harrington, 1964)

FRUIT: A capsule 3-4 mm long, seeds minute  
(Reynolds & Alexander, 1974; Harrington, 1964); Seed 0.45 mm long and 0.17 mm wide  
(Merkel, 1957)

#### PROCUREMENT

SEED MATURITY: Apr-Oct AZ (Reynolds & Alexander, 1974); Jun-Nov, best in Aug KA  
(Merkel, 1957)

METHOD OF COLLECTION: Hand strip into container (Reynolds & Alexander, 1974)

METHOD OF CLEANING: Not recommended (Reynolds & Alexander, 1974)

#### PRETREATMENT

METHOD OF STORAGE: Store at 40°F (Reynolds & Alexander, 1974); Store at 10°F (Merkel, 1957)

DURATION OF GOOD VIABILITY: Up to 2 years  
(Reynolds & Alexander, 1974; Horton et al., 1960); 3 months at 2-5°C (Hullett & Tomanek, 1961); 6-17 weeks at room temperature, 1-5 weeks in greenhouse (Horton et al., 1960); 9 months at 10°C (Merkel, 1957)

STRATIFICATION AND SCARIFICATION: None necessary (Reynolds & Alexander, 1974)

#### LABORATORY GERMINATION

TEMPERATURE: Constant at 70°F (Reynolds & Alexander, 1974)

MOISTURE: Saturated (Hullett & Tomanek, 1961; Horton et al., 1960)

LIGHT: Light not necessary (Horton et al., 1960)

GERMINATIVE ENERGY: 78% in 1 day (Reynolds & Alexander, 1974)

GERMINATIVE CAPACITY: 88% in 6 days (Reynolds & Alexander, 1974); 43-66% (Hullett & Tomanek, 1961); 19.6-32.5% in 6 days  
(Merkel, 1957)

COMMENTS: Highest germination rate from seed harvested in August and lowest in June  
(Merkel, 1957)

#### CULTURAL PRACTICES

PLANTING DEPTH: Best germination at surface, best establishment from 1/4-1/2" (Hullett & Tomanek, 1961)

PLANTING TIME: Spring (Stark, 1966); Anytime in summer when sufficient moisture is available (Hullett & Tomanek, 1961)

EXPOSURE: Sun (Stark, 1966)

SOIL pH: Alkali tolerant (Stark, 1966); Will germinate between pH 2.2 and 10.0, best germination between pH 5.6 to 7.0 (Hullett & Tomanek, 1961)

SOIL SALINITY: Will germinate in 100-10,000 ppm NaCl (Hullett & Tomanek, 1961)

SOIL MOISTURE: Moderately moist to wet, drought tolerant (Stark, 1966); Saturated for germination (Hullett & Tomanek, 1961)

NURSERY PLANTING: Soil must be kept constantly moist during establishment (Reynolds & Alexander, 1974)

*TETRADYMIA CANESCENS* DC.  
(Gray Horsebrush)

FAMILY: Asteraceae

LIFEFORM: Native shrub 20-100 cm tall (Harrington, 1964)

FRUIT: A silky hairy achene (Harrington, 1964)

#### CULTURAL PRACTICES

EXPOSURE: Sun (Stark, 1966)

SOIL TEXTURE: Coarse (Stark, 1966)

SOIL pH: Slight saline-alkaline tolerance  
(Stark, 1966)

SOIL DEPTH: 30-60" (Stark, 1966)

SOIL MOISTURE: Dry (Stark, 1966)

PRECIPITATION: 4-12" (Stark, 1966)

NURSERY PLANTING: Poor germination (Stark, 1966)

*TETRADYMIA SPINOSA* Hook. & Arn.  
(Cottonthorn Horsebrush)

FAMILY: Asteraceae

LIFEFORM: Native shrub 50-120 cm tall (Harrington, 1964)

FRUIT: An achene (Harrington, 1964)

#### PROCUREMENT

SEED MATURITY: Jun-Aug (Swingle, 1939)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 2% (Swingle, 1939)

*VACCINIUM CAESPITOSUM* Michx.  
(Dwarf Blueberry)

FAMILY: Ericaceae

LIFEFORM: Native shrub 5-30 cm tall (Harrington, 1964)

FRUIT: A many seeded berry 6-8 mm wide (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 3,700,000-6,000,000--avg 5,300,000 (Crossley, 1974)

SEED MATURITY: Jul-Sep (Crossley, 1974)

METHOD OF COLLECTION: Hand pick or beat bush into container (Crossley, 1974)

METHOD OF CLEANING: Chill to 50°F, macerate in water and float off, dry (Crossley, 1974)

#### PRETREATMENT

METHOD OF STORAGE: Store dry at 41°F (Crossley, 1974)

DURATION OF GOOD VIABILITY: 12 years (Crossley, 1974)

STRATIFICATION AND SCARIFICATION: Not necessary (McLean, 1967); Moist chill 71-112 days (Nichols, 1934)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 96% (Crossley, 1974; McLean, 1967); 33% in 28-169 days (Nichols, 1934)

#### CULTURAL PRACTICES

EXPOSURE: Shade or sun (Sutton & Johnson, 1974)

SOIL TEXTURE: Medium to coarse on granite soils (Sutton & Johnson, 1974)

SOIL pH: 5.5-7.0 (Sutton & Johnson, 1974)

SOIL DEPTH: Moderate to shallow (Sutton & Johnson, 1974)

SOIL MOISTURE: Moist (Sutton & Johnson, 1974)

ORGANIC MATTER: Yes (Sutton & Johnson, 1974)

DRAINAGE: Well drained (Sutton & Johnson, 1974)

FIELD PLANTING: Blueberries are exacting in their site requirements (Crossley, 1974)

*VIBURNUM LENTAGO* L.  
(Nannyberry)

FAMILY: Caprifoliaceae

LIFEFORM: Introduced shrub or small tree to 10 m tall (Harrington, 1964)

FRUIT: A 1-seeded drupe 10-15 mm long (Harrington, 1964)

#### PROCUREMENT

SEEDS/LB: 4,320-12,450 (Swingle, 1939)

SEED MATURITY: Sep-Oct (Gill & Pogge, 1974d); Aug-Sep, fall (Swingle, 1939)

#### PRETREATMENT

METHOD OF STORAGE: Store dry in sealed containers at 2°C (Hartmann & Kester, 1975); Best germination when stored in the pulp at 5°C and then cleaned before planting (Giersbach, 1937b)

DURATION OF GOOD VIABILITY: 1-2 years (Hartmann & Kester, 1975)

STRATIFICATION AND SCARIFICATION: Warm stratify at 20-30°C for 2-9 months then moist chill at 4°C for 2-4 months (Hartmann & Kester, 1975); Stratify 1 year (Swingle, 1939)

#### CULTURAL PRACTICES

PLANTING TIME: Plant in summer or early fall for next spring germination (Hartmann & Kester, 1975)

EXPOSURE: Sun or partial shade (Gill & Pogge, 1974d)

SOIL pH: Acid tolerant (Gill & Pogge, 1974d)

SOIL MOISTURE: Moist (Gill & Pogge, 1974d)

DRAINAGE: Well drained (Gill & Pogge, 1974d)

GREENHOUSE PLANTING: Reproduces well from cuttings (Swingle, 1939)

FIELD PLANTING: Should use heavy mulch first year, germinates best when spring has a warm period for germination followed by a cold period to force epicotyl development (Giersbach, 1937b)

*VITIS RIPARIA* Michx.  
(Riverbank Grape)

SYNONYMY: *Vitis vulpina*

FAMILY: Vitaceae

LIFEFORM: Native woody vine, attaining a length of 10-30 ft (Vines, 1960)

FRUIT: A berry 1/4-1/3" in diameter (Vines, 1960)

#### PROCUREMENT

SEEDS/LB: 14,500 (Vines, 1960); 7,400-17,210 (Swingle, 1939)

SEED MATURITY: Sep-Oct southwest U.S. (Vines, 1960); Sep or fall (Swingle, 1939)

#### PRETREATMENT

METHOD OF STORAGE: Dry (Swingle, 1939)

STRATIFICATION AND SCARIFICATION: Moist chill Nov thru Mar (Swingle, 1939)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 96% (Swingle, 1939)

COMMENTS: Seed germination is quick and vigorous (Vines, 1960)



## CULTURAL PRACTICES

PLANTING TIME: Stratified seed in spring (Swingle, 1939)  
GREENHOUSE PLANTING: Reproduces well from cuttings (Vines, 1960; Swingle, 1939)

*YUCCA ANGUSTISSIMA* Engelm. ex Trel.  
(Fineleaf Yucca)

FAMILY: Agavaceae  
LIFEFORM: An evergreen shrub 20-40 cm tall (Harrington, 1964)  
FRUIT: A dehiscent capsule 3.5-5 cm long (Harrington, 1964)

## PROCUREMENT

METHOD OF COLLECTION: Hand pick or strip onto canvas (Alexander & Pond, 1974)  
METHOD OF CLEANING: Tumble and screen (Alexander & Pond, 1974)

## PRETREATMENT

METHOD OF STORAGE: Sealed container at 70°F (McCleary & Wagner, 1973)  
DURATION OF GOOD VIABILITY: 1 year (McCleary & Wagner, 1973)

## LABORATORY GERMINATION

TEMPERATURE: Constant at 20°C (McCleary & Wagner, 1973)  
GERMINATIVE ENERGY: 14% in 11 days (McCleary & Wagner, 1973)  
GERMINATIVE CAPACITY: 28% in 16 days (McCleary & Wagner, 1973); 78% (Swingle, 1939)

*YUCCA BACCATA* Torr.  
(Spanish Bayonet)

FAMILY: Agavaceae  
LIFEFORM: Native evergreen shrub 40-75 cm tall (Harrington, 1964)  
FRUIT: An indehiscent capsule 15-20 cm long (Harrington, 1964)

## PROCUREMENT

METHOD OF COLLECTION: Hand pick or strip onto canvas (Alexander & Pond, 1974)  
METHOD OF CLEANING: Tumble & screen (Alexander & Pond, 1974)

## PRETREATMENT

METHOD OF STORAGE: Dry at 70°F (Alexander & Pond, 1974); Sealed container at 70°F (McCleary & Wagner, 1973)  
DURATION OF GOOD VIABILITY: 1 year (McCleary & Wagner, 1973)

## LABORATORY GERMINATION

TEMPERATURE: Constant between 60-70°F (Milstein & Milstein, 1966); Constant at 25°C (McCleary & Wagner, 1973)  
LIGHT: Best germination in light (Milstein & Milstein, 1966)  
GERMINATIVE ENERGY: 50% in 3 days (McCleary & Wagner, 1973)  
GERMINATIVE CAPACITY: Complete in 15-30 days (Milstein & Milstein, 1976); 100% in 7 days (McCleary & Wagner, 1973); 78% (Swingle, 1939)

## CULTURAL PRACTICES

EXPOSURE: Sun (Stark, 1966)  
SOIL TEXTURE: Medium to coarse (Stark, 1966)  
SOIL pH: Found on limestone soils (Stark, 1966)  
SOIL MOISTURE: Dry (Stark, 1966)  
PRECIPITATION: 6" (Stark, 1966)  
NURSERY PLANTING: Grown from seed successfully (Stark, 1966)

*YUCCA GLAUCA* (Nutt.)  
(Great Plains Yucca)

FAMILY: Agavaceae  
LIFEFORM: Native evergreen shrub with leaves to 3 ft tall (Vines, 1960)  
FRUIT: A dehiscent capsule approx 3 cm long (Harrington, 1964)

## PROCUREMENT

SEEDS/LB: 26,000-28,000 (Eddleman, 1977); 22,680 (Alexander & Pond, 1974)  
SEED MATURITY: Aug-Sep (Alexander & Pond, 1974)  
METHOD OF COLLECTION: Hand pick or strip onto canvas (Alexander & Pond, 1974)  
METHOD OF CLEANING: Tumble and screen (Alexander & Pond, 1974)

## PRETREATMENT

METHOD OF STORAGE: Store dry at 70°F (Alexander & Pond, 1974); Sealed container at 70°F (McCleary & Wagner, 1973)  
DURATION OF GOOD VIABILITY: 1 year (McCleary & Wagner, 1973)  
STRATIFICATION AND SCARIFICATION: Moist chill at 4°C for 1-3 months (Eddleman, 1977); Moist chill 1 month (Milstein & Milstein, 1976); Soak in water for 24 hours at 70°F (Alexander & Pond, 1974)

## LABORATORY GERMINATION

TEMPERATURE: Constant at 60-70°F (Milstein & Milstein, 1976); Constant at either 82-90°F or 20°C (Alexander & Pond, 1974); Constant at 25°C (McCleary & Wagner, 1973)  
LIGHT: Best germination in light (Milstein & Milstein, 1976)

GERMINATIVE ENERGY: 50% in 6-10 days (Eddleman, 1977); 80-90% in 4 days (Alexander & Pond, 1974); 50% in 5.5 days (McCleary & Wagner, 1973)  
GERMINATIVE CAPACITY: 83-91% (Eddleman, 1977); Complete in 15-30 days (Milstein & Milstein, 1976); 80% in 20 days (Alexander & Pond, 1974); 100% in 8 days (McCleary & Wagner, 1973); Complete in 4 days (Webber, 1953); 32% (Swingle, 1939)

#### CULTURAL PRACTICES

PLANTING TIME: Spring (Alexander & Pond, 1974)  
SOIL TEXTURE: Coarse (Eddleman, 1977)  
GREENHOUSE PLANTING: Only 20% survival from greenhouse planting (Arnott, 1962)  
NURSERY PLANTING: Mulch the first fall before frost (Alexander & Pond, 1974)  
FIELD PLANTING: In nature reproduction by seed is limited, seedlings grow slowly, seeds may not germinate for one to several years (Webber, 1953)

<p><i>YUCCA HARRIMANIAE</i> Trel. (Harriman Yucca)</p>
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FAMILY: Asteraceae  
LIFEFORM: Native evergreen shrub with leaves 4-18" long (Vines, 1960)  
FRUIT: A dehiscent capsule 4-5.7 cm long (Harrington, 1964)

#### LABORATORY GERMINATION

GERMINATIVE CAPACITY: 58% (Swingle, 1939)

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# APPENDIX I

Colorado shrub species that have been evaluated by the USDA  
Soil Conservation Service Plant Materials Centers

Species	State <sup>1</sup>									
	AR	CA	CO	ID	KA	MT	NM	OR	TX	WA
<i>Acer glabrum</i>			X	X						
<i>Amelanchier alnifolia</i>			X		X		X			
<i>A. utahensis</i>			X	X						
<i>Amorpha canescens</i>					X					
<i>A. fruticosa</i>					X	X	X		X	
<i>Arctostaphylos patula</i>		X	X							
<i>A. uva-ursi</i>		X	X							
<i>Artemisia arbuscula nova</i>		X	X							
<i>A. cana</i>		X								
<i>A. frigida</i>			X	X		X				
<i>A. nova</i>			X	X						
<i>A. spinescens</i>		X		X						
<i>A. tridentata</i>		X	X							
<i>Atriplex canescens</i>	X	X	X	X		X	X		X	
<i>A. confertifolia</i>	X	X	X	X			X			
<i>A. corrugata</i>			X							
<i>A. cuneata</i>			X				X			
<i>A. gardneri</i>		X								
<i>A. nuttallii</i>		X	X	X		X	X			
<i>A. obovata</i>							X			
<i>Berberis fendleri</i>			X							
<i>B. repens</i>			X							
<i>Ceanothus fendleri</i>									X	
<i>C. ovatus</i>					X					
<i>C. velutinus</i>		X	X	X						
<i>Ceratoides lanata</i>			X	X		X				
<i>Cercocarpus intricatus</i>			X							
<i>C. ledifolius</i>		X	X	X						
<i>C. montanus</i>			X	X		X	X		X	
<i>Chrysothamnus depressus</i>			X				X			
<i>C. nauseosus</i>		X	X				X			
<i>C. parryi</i>			X							
<i>C. viscidiflorus</i>		X	X	X						
<i>Clematis ligusticifolia</i>			X	X			X			
<i>Coleogyne ramosissima</i>		X								
<i>Cornus stolonifera</i>		X	X		X		X			
<i>Cowania stansburiana</i>		X	X	X			X			
<i>Crataegus</i> spp.			X							
<i>Elaeagnus umbellata</i>		X	X		X	X	X		X	



## Appendix I.--Continued

Species	State <sup>1</sup>									
	AR	CA	CO	ID	KA	MT	NM	OR	TX	WA
<i>Ephedra torreyana</i>			X							
<i>E. viridis</i>		X		X			X			
<i>Eurotia lanata</i>	X	X	X				X			
<i>Fallugia paradoxa</i>	X		X				X			
<i>Fendlera rupicola</i>			X				X			
<i>Forestiera neomexicana</i>		X	X		X	X	X		X	
<i>Grayia spinosa</i>		X	X							
<i>Haplopappus</i> spp.			X							
<i>Holodiscus dumosus</i>			X							
<i>Jamesia americana</i>			X							
<i>Juniperus communis</i>			X		X					
<i>J. horizontalis glauca</i>					X					
<i>Kochia americana</i>		X								
<i>Larrea tridentata</i>	X	X								
<i>Lonicera involucrata</i>			X		X				X	
<i>L. utahensis</i>			X							
<i>Lycium halimifolium</i>						X			X	
<i>Mahonia fremontii</i>			X							
<i>M. repens</i>			X							
<i>Menodora scabra</i>	X									
<i>Nolina microcarpa</i>			X				X			
<i>Parthenocissus vitacea</i>			X							
<i>Penstemon ambiguus</i>			X							
<i>Peraphyllum ramosissimum</i>			X							
<i>Philadelphus microphyllus</i>			X							
<i>Physocarpus monogynus</i>			X							
<i>Potentilla fruticosa</i>			X		X		X			
<i>Prunus besseyi</i>					X					
<i>P. virginiana</i>			X	X		X	X			
<i>Purshia tridentata</i>		X	X	X			X			
<i>Quercus gambelii</i>			X				X			
<i>Rhamnus smithii</i>			X							
<i>Rhus glabra</i>			X	X	X	X	X		X	
<i>R. trilobata</i>		X	X	X	X	X	X		X	
<i>Ribes americanum</i>			X							
<i>R. aureum</i>			X	X						
<i>R. cereum</i>			X				X			
<i>R. leptanthum</i>							X			
<i>R. montigenum</i>			X							
<i>Rosa arkansana</i>					X					
<i>R. multiflora</i>					X					
<i>R. nutkana</i>		X	X							
<i>R. woodsii</i>		X	X				X			
<i>Rubus deliciosus</i>			X							
<i>R. parviflorus</i>		X	X		X					

## Appendix I.--Continued

Species	State <sup>1</sup>									
	AR	CA	CO	ID	KA	MT	NM	OR	TX	WA
<i>Salix interior</i>					X					
<i>S. lasiandra</i>		X								
<i>S. purpurea nana</i>						X				
<i>Sambucus canadensis</i>									X	
<i>S. coerulea</i>		X					X			
<i>S. pubens</i>			X							
<i>S. racemosa</i>					X		X			
<i>Sapindus drummondii</i>									X	
<i>Sarcobatus vermiculatus</i>		X	X							
<i>Shepherdia argentea</i>			X		X	X	X			
<i>Sorbus scopulina</i>			X							
<i>Symphoricarpos albus</i>			X				X			
<i>S. longiflorus</i>		X								
<i>S. occidentalis</i>			X							
<i>S. orbiculatus</i>					X				X	
<i>S. oreophilus</i>			X				X			
<i>S. vaccinoides</i>		X								
<i>Tetradymia canescens</i>			X							
<i>Yucca angustissima</i>						X				
<i>Y. baccata</i>		X	X							
<i>Y. glauca</i>					X		X			
<i>Y. harrimaniae</i>			X							

<sup>1</sup>STATE: AR = Arizona; CA = California; CO = Colorado; ID = Idaho; KA = Kansas; MT = Montana; NM = New Mexico; OR = Oregon; TX = Texas; WA = Washington.





## APPENDIX II

### Western USDA Soil Conservation Service Plant Materials Centers

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3241 Romero Road  
Tucson, Ariz. 85705

P.O. Box 68  
Lockeford, Calif. 95236

P.O. Box 448  
Meeker, Colo. 81641

Box AA  
Aberdeen, Idaho 83210

Route 2, Box 314  
Manhattan, Kans. 66509

Route 1, Box 81  
Bridger, Mont. 59014

1036 Miller Street, S.W.  
Los Lunas, N. M. 87031

3420 N.E. Granger Avenue  
Corvallis, Oreg. 97330

Box 648  
Temple, Texas 76501

257 Johnson Hall  
Washington State University  
Pullman, Wash. 99163

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## APPENDIX III

### Commercial suppliers of Colorado shrubs

Supplier	Supplier's number
Applewood Seed Co. 833 Parfet Street Lakewood, Colo. 80215	1
Arborland Nursery 22465 Colorado State Hwy. Milliken, Colo. 80543	2
Arkansas Valley Seeds, Inc. P.O. Box 270 Rocky Ford, Colo. 81067	3
Clarkdale Nursery Milbank, S. D. 57252	4
Desert Enterprises P.O. Box 23 Morristown, Ariz. 85342	5
Fey's Nursery and Seed Sheldon, N. D. 58068	6
Flowerland Garden 4181 West 120 Avenue Broomfield, Colo. 80020	7
Boyd E. Goble and Sons Seed Co. P.O. Box 175 Gunnison, Utah 84634	8
Grassland Resources, Inc. P.O. Box 1596 Sante Fe, N. M. 87501	9
Hardi Gardens 6506 South Broadway Littleton, Colo. 80121	10
Highland Nursery 5002 West 20 Street Greeley, Colo. 80631	11
Lawyer Nursery Route 2, Box 95 Plains, Mont. 59859	12
Lincoln-Oakes Nurseries Box 1601 Bismarck, N. D. 58501	13
Mile High Seed Co. P.O. Box 1988 Grand Junction, Colo. 81501	14



## Appendix III.--Continued

Supplier	Supplier's number
Morgan Nursery 2200 Reservoir Road Greeley, Colo. 80631	15
Mountain Meadows Nursery 5050 Coal Mine Road Littleton, Colo. 80123	16
Native Plants P.O. Box 15526 Salt Lake City, Utah 84115	17
Northplan Seed Producers P.O. Box 9107 Moscow, Idaho 83843	18
Nuzum Nurseries 96 Arapahoe Avenue Boulevard Denver, Colo.	19
Plumfield Nurseries, Inc. P.O. Box 410 2105 North Nye Avenue Fremont, Nebr. 68025	20
Powder River Seed Co. Box 673 Broadus, Mont. 59317	21
Rocky Mountain Natives Wholesale Nursery 2221 North Whitcomb Fort Collins, Colo. 80521	22
Sharp Brothers Seed Co. Healy, Kans. 67850	23
J. H. Skinner and Co. Nursery Box 8068 1402 L. Silver Lake Road Topeka, Kans. 66608	24
South Denver Evergreen Nursery 1534 South Broadway Denver, Colo. 80210	25
Valley Seed Co. P.O. Box 1110 Phoenix, Ariz. 85001	26
Western Evergreen 14201 West 44 Avenue Golden, Colo. 80401	27
Woodman Brothers 1801 West Belleview Littleton, Colo. 80120	28

## APPENDIX IV

### Commercial suppliers of Colorado shrubs, seeds, seedlings, or transplants

Species	Seed	Seedling <sup>2</sup>	Transplant <sup>3</sup>
<i>Acer glabrum</i>	12,16,18,25,27	12	16,17,22,25,27
<i>Amelanchier alnifolia</i>	8,12,16,18,23,27	12,20	16,17,22,27
<i>Amelanchier utahensis</i>	8		17,22
<i>Amorpha canescens</i>	16,18,21,27		16,22,27
<i>Amorpha fruticosa</i>	12		
<i>Arctostaphylos patula</i>	18		
<i>Arctostaphylos uva-ursi</i>	10,12,18,25	12	22
<i>Artemisia abrotanum</i>	8		17
<i>Artemisia arbuscula nova</i> ( <i>A. nova</i> )	8,23		
<i>Artemisia cana</i>	21		
<i>Artemisia filifolia</i>			17,27
<i>Artemisia frigida</i>	16		17
<i>Artemisia tridentata</i>	8,12,18,21,23		17,22,27
<i>Artemisia vaseyana vaseyana</i> ( <i>A. tridentata vaseyana</i> )	8		
<i>Atriplex canescens</i>	5,8,9,12,14, 18,21,23,25		17,22
<i>Atriplex confertifolia</i>	8,18,21		
<i>Atriplex cuneata</i>			17
<i>Atriplex gardneri</i>	8		22
<i>Atriplex nuttallii</i>	12,21		
<i>Ceanothus martinii</i>	8		22
<i>Ceanothus velutinus</i>	12		22
<i>Ceratoides lanata</i> ( <i>Eurotia lanata</i> )	8,21,23		22
<i>Cercocarpus ledifolius</i>	8,16,23		22
<i>Cercocarpus montanus</i>	7,8,10,16,23,27		7,10,16,17,22,27
<i>Chrysothamnus lanceolatus</i> ( <i>C. viscidiflorus lanceolatus</i> )	21		
<i>Chrysothamnus nauseosus</i>	1,8,12,18,21,23		17,22
<i>Chrysothamnus stenophyllus</i> ( <i>C. viscidiflorus stenophyllus</i> )	8		
<i>Chrysothamnus viscidiflorus</i>	8		
<i>Clematis ligusticifolia</i>			17
<i>Colutea arborescens</i>	23		
<i>Cornus stolonifera</i>	8,12,18	12,13,20,24	17,22
<i>Cowania mexicana stansburiana</i>	8,23		17,22
<i>Elaeagnus angustifolia</i>	8,12	4,13,24	17,22
<i>Elaeagnus commutata</i>	12	13	
<i>Ephedra viridis</i>	8,12,18,23		17,22
<i>Fallugia paradoxa</i>	16,27		16,22,27
<i>Forestiera neomexicana</i>	27		17,27
<i>Jamesia americana</i>			22
<i>Juniperus communis</i>		12	17
<i>Lonicera involucrata</i>	8		
<i>Mahonia repens</i> ( <i>Berberis repens</i> )	7,8,10,12,16, 18,19		17,22,27
<i>Opuntia erinacea</i>	5		

(continued)

## Appendix IV.--Continued

Species	Seed	Seedling <sup>2</sup>	Transplant <sup>3</sup>
<i>Opuntia imbricata</i> ( <i>Cylindropuntia imbricata</i> )	5		
<i>Opuntia phaeacantha</i>	5		
<i>Peraphyllum ramosissimum</i>	8,23		17
<i>Physocarpus malvaceus</i>			22
<i>Physocarpus monogynus</i>	16		
<i>Potentilla fruticosa</i>		24	
<i>Prunus americana</i>	8,12	4,6,13,20,24	6,27
<i>Prunus besseyi</i>	2,11,12,15	4,6,20,24	6,27
<i>Prunus virginiana melanocarpa</i>	8,18	13,20	4,16,17,27
<i>Purshia tridentata</i>	8,12,18,23,27		17,22,27
<i>Quercus gambellii</i>	7,8		16,17,19,22,27
<i>Rhamnus cathartica</i>		12	
<i>Rhus glabra cismontana</i>	12,18	24	16,17,22,27
<i>Rhus trilobata</i>	8,12,16,18,21, 25,27		4,16,17,25,22 27
<i>Ribes aureum</i>	8,12	12,13,20	16,17,22
<i>Ribes inerme</i>	28		28
<i>Ribes leptanthum</i>	28		28
<i>Rosa nutkana</i>	18		
<i>Rosa woodsii</i>	1,8,18		17,22
<i>Rubus parviflorus</i>			22
<i>Salix purpurea lambertiana</i>	20		
<i>Sambucus coerulea</i>	8,18		17
<i>Sambucus racemosa pubens</i>	21,27		22,27
<i>Sarcobatus vermiculatus</i>	8		
<i>Shepherdia argentea</i>	2,12	13,20	4,11,15,17,27, 28
<i>Sorbus scopulina</i>	12,18		17
<i>Symphoricarpos albus</i>	12,18,27	12	22,27
<i>Yucca baccata</i>	1		
<i>Yucca glauca</i>	1,12,21	12,13	22

<sup>1</sup>Suppliers are identified by number shown in appendix III.

<sup>2</sup>Seedling--bare root stock.

<sup>3</sup>Transplant--tubeling or potted plant.



# INDEX TO SCIENTIFIC NAMES

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E R R A T A

Vories, Kimery C. 1981. Growing Colorado plants from seed: a state of the art. Volume 1: Shrubs. USDA For. Serv. Gen. Tech. Rep. INT-103, 80 p.

Appendix III, page 74:

The address for Native Plants should be:

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Information included relates to seed procurement, pre-treatment, laboratory germination, and culture of 127 Colorado shrub species. Also included are 234 literature citations, a list of the Colorado shrub species that have been evaluated by USDA Soil Conservation Plant Materials Centers, addresses of plant material centers in the western United States, a list of the commercial suppliers of Colorado shrub, seed, seedlings, and transplants, and a list of the addresses of commercial suppliers of Colorado shrubs.

KEYWORDS: germination, propagation, shrubs, Colorado seeds, field planting

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The Intermountain Station, headquartered in Ogden, Utah, is one of eight regional experiment stations charged with providing scientific knowledge to help resource managers meet human needs and protect forest and range ecosystems.

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